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PHYSICS AND MATHEMATICS

No. 35

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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

Physics and Mathematics

No. 35

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STATIONARY STRATEGIES IN DIFFERENTIAL GAMES

MALAFEYEV, O. A., Leningrad

[Abstract] The author considers games with dynamics given by the differential system

$$\dot{x} - f(x,u,v)$$

that satisfies the following conditions:

1) $x \in R^m = X$, where R^m is an m-dimensional euclidean space, $t \in (0, \infty)$, $u \in U \subset R^p$, $v \in V \subset R^q$; U, V are compact sets;

2)   f is continuous with respect to (x,u,v) on $R^m \times U \times V$;

3)   f satisfies the Lipschitz condition with respect to x;

4)   Positive numbers M, M' exist such that for all $x \in R^m$, $u \in U$, $v \in V$

$$\|f(x, u, v)\| \leq M + M' \|x\|,$$

where $\|x\|$ is the norm of x;

5)   The sets $F'(x) = \{y \mid y = f(x, u, v), u \in U, v \in V\}$ are convex and closed for all $x \in R^m$.

It is proved that situations of $\mathcal{E}$-equilibrium exist in the class of mixed stationary strategies. References 6: 2 Russian, 4 Western.

PHYSICS
Acoustics

ATTENUATION OF THE AVERAGE FIELD IN AN IRREGULAR WAVEGUIDE

LAPIN, A. D., Acoustics Institute, Academy of Sciences USSR

[Abstract] Attenuation of the average field is calculated in a waveguide
with weakly nonhomogeneous filler. The simplest waveguide is considered--
a liquid layer bounded by ideally compliant walls $z = 0$ and $z = h$, assuming
that properties are independent of the y-coordinate and that all motion
takes place in the xz plane (two-dimensional problem). The filler is taken
as homogeneous in the left half-waveguide ($x < 0$) and statistically nonhomo-
geneous in the right half-waveguide ($x > 0$). The deviation of the index of
refraction of the non-homogeneous medium from the average value (taken as
unity) is small: $|\mu| \ll 1$. It is assumed that a normal wave is incident
from the left half-waveguide into the right, and the average field is found
in the right half-waveguide. The analysis makes use of the fact that as
sound propagates in an irregular waveguide, the coherent component of the
sound field (average field) is irreversibly dissipated into the incoherent
component; there is not scattering from the incoherent field component to
the coherent component. It is assumed that formulas obtained in the first
approximation of the method of small perturbations are applicable. An
asymptotic expression is found for the attenuation of the normal wave as
the product of the wave number and the width of the waveguide approaches
infinity. Coefficients of attenuation are calculated by this formula for
wave propagation velocity of 1500 m/s and h =5000 m for different nonhomo-
geneity and waveguide parameters. Comparative data are given for attenua-
tion due to absorption of sound in sea water. An expression is also found
for attenuation due to irregularities in the waveguide walls. References
8 (Russian).

USSR   UDC 534.833.524

ON EVALUATING THE ABSORPTION OF ENERGY OF COUPLED FLEXURAL AND LONGITUDINAL
OSCILLATIONS OF BOUNDED STRUCTURES

KANAYEV, B. A., RYBAK, S. A., and TARTAKOVSKIY, B. D., Acoustics Institute,
Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] An evaluation is made of the influence that coupling of longitudinal
and flexural vibrations of bounded structures has on the effectiveness of
vibration damping by application of vibration-absorbing coverings. The re-
lations found for the energy of flexural and longitudinal vibrations are used
to determine the way that the damping effect depends on the parameters of
the structure. References 9: 5 Russian, 4 Western.

USSR   UDC 549.88

CHARACTERISTICS OF A DIGITAL MODEL OF THE AUDITORY NEURON

LOMDZHARIYA, N. M., and SHAPIRO, V. M., Acoustics Institute, Academy of
Sciences USSR

[Abstract] The article describes an algorithm for the Minsk-22 computer
that simulates the action of an isolated neuron of the auditory system.
The proposed digital model accounts for the following properties of actual
neurons: 1) the nature of the time behavior of the post-synaptic potential;
2) generation of a spike when the post-synaptic potential reaches a certain
threshold value; 3) the presence of absolute and relative refractory phases
after generation of a spike; 4) statistical properties of the post-synaptic
potential. The program of the neuron model is briefly outlined and a flow-
chart is given of the algorithm of the program. A comparison of the main
characteristics of the model with neurophysiological data shows that the
pulse response of the model agrees well with the tone responses of neurons
of the peripheral levels of the auditory system. The model can also be used
to study the influence on neuron response for parameters that are difficult
or impossible to control in neurophysiological experiments, such as thresholds
or the time constant that determines the integrating properties of the neuron
membrane. References 12: 4 Russian, 8 Western.

ON THE THEORY OF SOUND GENERATION WHEN INTENSITY-MODULATED LASER EMISSION
IS ABSORBED IN A LIQUID WAVEGUIDE

LYAMSHEV, L. M. and SEDOV, L. V., Acoustics Institute, Academy of Sciences
USSR

[Russian abstract provided by the source]

[Text] A theoretical analysis is done on the generation of sound in a liquid
waveguide when intensity-modulated laser radiation is absorbed in the wave-
guide. It is assumed that the mechanism whereby sound is produced is purely
thermal in nature, and steady-state generation is considered. The field in
the waveguide is considered as a sum of normal waves; final expressions are
found for the amplitudes of these waves for the case of gaussian distribu-
tion of the intensity of optical emission. The maximum efficiency of optical
generation of sound in a waveguide is evaluated. It is shown that the ef-
ficiency of generation of normal waves of certain frequencies can be enhanced
by changing the parameters of the laser beam. An estimate is made of the in-
fluence that random fluctuations of transverse distribution of intensity in
the laser beam have on the sound field in the waveguide. References 4:
3 Russian, 1 Western.

SCATTERING OF A PLANE AXIAL-SHEAR WAVE BY A CIRCULAR PIEZOELECTRIC SEMI-
CONDUCTOR CYLINDER

LYAMSHEV, L. M. and SHEVYAKHOV, N. S., Acoustics Institute, Academy of Sci-
ences USSR, Mordovian State University imeni N. P. Ogarev

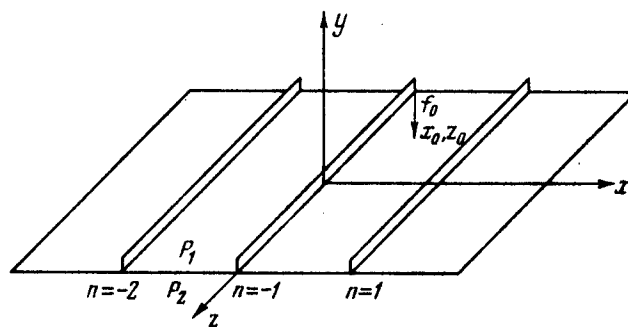[Russian abstract provided by the source]

[Text] A solution is found for the problem of scattering of a plane shear
wave by a piezoelectric semiconductor cylinder; both the cylinder and the
ambient medium belong to piezoelectrics of class C_{6V} (6 mm). It is shown
that waves scattered by the cylinder may be amplified in the case of certain
values of supersonic drift. The authors discuss the wave modes in the cy-
linder that lead to amplification of scattered waves when these modes are
pumped up by drifting charge carriers. References 20: 15 Russian, 5
Western.

EMISSION OF SOUND BY AN INFINITE PLATE WITH A FINITE NUMBER OF RIBS SET INTO
VIBRATION BY A CONCENTRATED FORCE

ROMANOV, V. N.

[Abstract] The author considers the problem of sound emission by a thin
flexurally vibrating plate in contact with a liquid on both sides and stiff-
ened by a periodic system of infinitely thin ribs. The plate is set in
bending vibrational motion by a concentrated force applied at the point with
coordinates x_0 and z_0. The coordinate system is shown in the figure.

It is assumed that the plate is infinite in extent, and is reinforced by a
finite number of ribs. The spatial distribution of sound pressure close
to the surface of the plate is determined. The results of numerical calcu-
lations are given,and an analysis is made of the way that pressure depends
on the distance from the plane of the plate and on the parameters of the
plate. The results show that each rib is an acoustic radiator with an out-
put that depends on its displacement and angle of deflection. The law of
damping of the pressure produced by the rib depends on the distance between
the rib and the point of excitation. Increasing the number of ribs does not
change the emission from preceding ribs. If the moment impedance of the
ribs is negligible, the acoustic radiation is determined mainly by ribs lo-
cated outside of the space where the concentrated force is applied. Refer-
ences 6 (Russian).

APPLICATION OF THE METHOD OF APPROXIMATE SEPARATION OF VARIABLES TO SOME
PROBLEMS OF VIBRATIONS OF CYLINDERS

SHEYBA, L. S. and SHLYAPOCHNIKOV, S. A.

[Abstract] The method of approximate separation of variables is applied to
some linear dynamic problems on longitudinal oscillations of hollow and
solid cylinders made of rubber-like material. Solutions found for an in-
finite cylinder are compared with known exact and approximate solutions.
The problem of oscillations of a finite cylinder between two flat plates
is considered, and formulas are derived that give the conduction matrix of
the cylinder. References 10: 9 Russian, 1 Western.

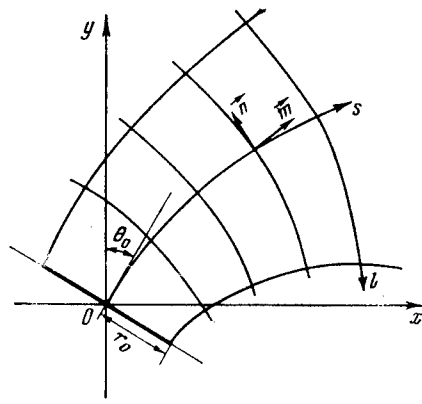ON A SOUND BEAM IN A NONHOMOGENEOUS MEDIUM WITH WEAKLY VARYING SPEED OF
SOUND

ZAREMBO, L. K. and CHUNCHUZOV, I. P., Physics Faculty, Chair of Acoustics,
Moscow State University imeni M. V. Lomonosov

[Abstract] The authors consider propagation of a sound beam produced by an
emitter of radius r_0, the axis of the beam being directed at an arbitrary
angle θ_0 to the gradient of the speed of sound in the medium. Methods of
linear geometric acoustics are used to determine the trajectories of rays
and of the lines of equal phase that are locally orthogonal to them. The
two-dimensional problem is considered, the independent variables being the
length s of a ray measured from the coordinate origin, and the transverse
coordinate l that is orthogonal to s. The geometry of the problem is shown
in the figure.

The special solution corresponding to nonlinear refraction of square pulses of the same polarity in a nonhomogeneous medium is considered. The solution is not applicable close to "turning points" of the ray trajectories or in the neighborhood of caustics. References 5 (Russian).

HUMAN AUDITORY EVALUATION OF THE MODULATION FREQUENCY OF AN AMPLITUDE-MODULATED TONE

ISHCHENKO, S. M., Acoustics Institute, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] A study is done on the ability of a person to estimate by ear the modulation frequency of an amplitude-modulated tone with frequency of 1000 Hz. It is shown that the absolute error in determination of modulation frequency is considerably dependent on the modulating frequency: with an increase in the modulation frequency from 1 to 10, from 10 to 20, and from 30 to 60 Hz, the error increases almost linearly from 0.1 to 0.4, from 0.4 to 6.2, and from 6.2 to 21. 8 Hz for the indicated ranges of modulating frequencies. On modulation frequencies of 20-30 and 60-100 Hz, the absolute error is nearly constant, and is equal to 6.2 and 20-21.8 Hz. The way that the error in determination of the modulation frequency depends on the modulating frequency can be attributed to the influence that integrating properties of the auditory system and crepitation of sound have on the accuracy of human evaluation of modulation frequency. References 6: 3 Russian, 3 Western.

POSSIBLE INFLUENCE OF LIBRATION TRANSITIONS ON ABSORPTION OF SOUND IN
LIQUID PROPYLENE

DUDAR', B. G. and MIKHAYLENKO, S. A., Physico-Technical Institute of Low
Temperatures, Academy of Sciences UkrSSR

[Russian abstract provided by the source]

[Text] A pulse method is used to measure the speed and absorption (α) of
sound on frequencies (f) of 5-126 MHz in liquid propylene on the saturation
line at 90-260 K. The particulars of the temperature dependence of α/f^2
are considered that distinguish propylene from other liquefied gases, and in
particular the presence of high excess absorption at 180-260 K. It is shown
that this effect can be attributed to the Kneser process of excitation and
deactivation of an intramolecular libration mode with characteristic times
of 10^{-11}-10^{-12} s. References 13: 11 Russian, 2 Western.

DIFFRACTION OF SOUND BY A PERIODIC NONHOMOGENEOUS SURFACE

VELIZHANINA, K. A. and GAMULIN, A. V., Moscow State University imeni M. V.
Lomonosov, Physics Department

[Russian abstract provided by the source]

[Text] Oblique incidence of sound on a nonhomogeneous periodic surface is
considered. Calculations done for the case of a rigid surface with slot-
like grooves showed that the apparent additional mass depends on the angle
of incidence of the sound. The nature of this dependence is found. The
threshold frequency at which the apparent mass begins to depend on the angle
of incidence is determined, as well as the degree of influence of various
factors. It is shown that the critical frequency at which the apparent mass
approaches infinity is lower for oblique incidence than for normal incidence
of sound. References 3: 2 Russian, 1 Western.

DISPERSION OF NORMAL FLEXURAL WAVES IN A THIN STRIP

BOBROVNITSKIY, YU. I., State Scientific Research Institute of Machine Science

[Abstract] Dispersion curves are given for normal flexural waves in clamped
and free thin elastic strips, including the complex branches. Particular
emphasis is placed on the multiple roots of dispersion equations. It is
shown that in the absence of attenuation on frequencies corresponding to
double roots, the displacement in the normal wave as a function of the longi-
tudinal and transverse coordinates can be described by the product of an ex-
ponential and a linear function. References 22: 15 Russian, 7 Western.

DEFOCUSING OF THE SOUND FIELD OF BOTTOM REFLECTIONS IN A NONHOMOGENEOUS
ANTICHANNEL

BARKHATOV, A. N. and GORSKAYA, N. V., Gor'kiy State University imeni N. I.
Lobachevskiy

[Abstract] In anti-waveguide sound propagation, a shadow zone is formed into
which energy can penetrate as a consequence of wave reflection from the bottom.
In continuously layered media with a negative vertical gradient in the speed
of sound (a homogeneous antichannel) the rays reflected from the bottom may
form caustics as a result of refraction in upper layers. These caustics are
observed in the sound field of the bottom reflections as regions of increased
concentration of sound energy. These caustics are disrupted in a nonhomoge-
neous antichannel, i.e., where regular nonhomogeneities reduce the vertical
gradient of the speed of sound in the direction of propagation. The authors
study the sound field in homogeneous and nonhomogeneous antichannels experi-
mentally by the method of physical scale modeling. Ray patterns are plotted
and focusing factors of the field are calculated. Graphs are given showing
the distribution of speed of sound with depth, and the intensity of sound
as a function of distance from the emitter. To study the influence of a
horizontal gradient in the speed of sound on the field formed by rays re-
flected from the bottom, horizontal nonhomogeneity was produced by nonuniform
heating of the surface of the water in the experimental tank. The results
show that bottom rays in a nonhomogeneous antichannel form caustics only
after the first reflection from the bottom, after which the rays are defocused.
References 3 (Russian).

THE SPEED OF SOUND IN NITROGEN-HELIUM MIXTURES AT HIGH PRESSURES

PITAYEVSKAYA, L. L. and KANISHCHEV, B. E., Institute of High-Pressure Physics,
Academy of Sciences USSR, Akademgorodok, Moskovskaya Oblast

[Abstract] The paper gives the results of measurement of the speed of sound
in nitrogen-helium mixtures at temperatures of 25, 50, 100 and 200°C in the
pressure range of 200-4000 bars at mole concentrations of helium in the mix-
ture of 31.3, 57.1, 78.7 and 94.8%, corresponding to weight concentrations
of helium of 6.1, 16.0, 34.6 and 72.2%. It was found that the speed of
sound increases smoothly with pressure, as in pure gases. At low pressures,
the helium admixture increases the speed of sound noticeably over that in
pure nitrogen, but this effect decreases with increasing pressure. As the
temperature is increased, the pressure at which the influence of helium on
the speed of sound disappears becomes higher. The results can be explained
by assuming that the speed of sound at high pressures is determined chiefly
by the interaction between its molecules rather than by kinetic energy, as
in an ideal gas. Since helium atoms are light and interact weakly with other
atoms, their influence decreases with increasing pressure. Adding nitrogen
to helium appreciably reduces the speed of sound. Thus the purity of helium
is very important for studying the speed of sound. References 7: 6 Russian,
1 Western.

INVESTIGATION OF AMPLIFICATION OF HIGH-INTENSITY ULTRASOUND IN CdS

ZHABITENKO, N. K., KUCHEROV, I. YA., MARCHENKO, A. T., and SLESAREV, YU. G.,
All-Union Scientific Research Institute of Analytical Instrument Making,
Kiev; Kiev State University imeni T. G. Shevchenko

[Russian abstract provided by the source]

[Text] An exmperimental study is done on amplification of shear waves for
different fields and conductivities. Linear amplification of high-power
ultrasound is observed up to 100 W/cm^2. Experimental data are quantitatively
compared with the results of calculation in accordance with a nonlinear theo-
ry of amplification of ultrasound. An analytical expression is found for
the limiting undistorted power as a function of the drift field, and the re-
sult is compared with experiment. The experimentally found intensity is
somewhat lower than the theoretical value. References 12: 7 Russian, 5
Western.

USSR

ABSOLUTE INSTABILITY OF A 'TRAPPED' PACKET OF ACOUSTIC WAVES IN AN ANISO-
TROPIC SEMICONDUCTOR PLATE

PUSTOVOYT, V. I., RAVVIN, I. S. and CHERNOZATONSKIY, L. A., All-Union Scien-
tific Research Institute of Physicotechnical and Radiotechnical Measurements

[Abstract] It is shown that the orientation of a plane-parallel plate of an
anisotropic semiconductor can be selected so that the group velocities of
the waves incident and reflected from its planes are parallel. In such a
case, the wave packet is trapped in the plate after passing twice between
the reflecting planes. The conditions of trapping of an acoustic wave pack-
et are derived. It is shown that absolute acoustic instability arises in
such a semiconductor when the trapped waves are amplified by drift of cur-
rent carriers. The theoretical predictions are confirmed by experiments
with a photoelectric CdSe crystal. References 4: 2 Russian, 2 Western.

USSR   UDC   534.84

ACOUSTIC INSULATION OF A RESONATOR CHAIN INSIDE A WIDE DUCT

LAPIN, A. D.

[Text] The acoustic insulation is calculated for a duct with a diameter
larger than the length of a sound wave and with a chain of axisymmetric
resonators connected to it inside at distances that are not small compared
with the length of a sound wave. The acoustic insulation of the resonator
chain acting as a reflector is determined by the ratio of incident to trans-
mitted acoustic energy fluxes in dB and is calculated here on the basis of
the fourpole network theory. The sound pressure in a duct is represented
as a superposition of normal waves of m-th order symmetry. General expres-
sions are shown for the fourpole input and output impedances, also for the
special cases of no load and short circuit, inasmuch as these determine the
transfer ratio of a fourpole. The amplitudes of normal waves are determined
with the aid of Green's theorem. Approximate expressions are derived for
these amplitudes, on the assumption that the width of a resonator inlet
aperture is smaller than the length of a sound wave. The frequency range is
established within which the formula for the acoustic insulation remains
valid.

CALCULATION OF THE MAXIMUM AMPLITUDE FOR A COMPOUND PIEZOELECTRIC TRANSDUCER

KAZANTSEV, V. F.

[Text] One major factor which limits the vibration amplitude of a compound piezoelectric transducer is the heating of its piezoceramic element. The temperature rise depends on the effectiveness of the cooling. The steady-state temperature is determined by the power balance of heat losses inside the system and heat flowing to the ambient medium. Here the power of heat sources is calculated in terms of the transducer vibration amplitude, and a nonhomogeneous equation of heat conduction is obtained for calculating the steady-state temperature as well as the corresponding maximum vibration amplitude of a compound transducer.

DEVELOPMENT OF A METHOD FOR MEASURING VIBRATIONAL STRAINS WITH AN ELECTRO-DYNAMIC GAUGE

BERLIN-RAUT, M. L. and KAZANTSEV, V. F.

[Text] The sensitivity of an electrodynamic gauge of vibration velocities is calculated here. A formula has been derived which relates the stress across the output terminals of this gauge to the magnetic permeability and the electrical conductivity of the test material, the natural frequency of the test specimen, and the geometrical parameters of the gauge. Calculations are also shown pertaining to the equivalent circuit of this electro-dynamic gauge.

MECHANICAL AND MAGNETOSTRICTIVE PROPERTIES OF MATERIALS FOR TRANSDUCERS IN
THE COMPRESSION MODE

GOLYAMINA, I. P. and CHULKOVA, V. K.

[Text] The results are reported of a study concerning the effect of mechani-
cal compressive stresses σ_0 on the magnetostriction constant α, on the modu-
lus of elasticity E, and on the mechanical Q-factor of the major Soviet me-
tallic materials: grade NPGT nickel, grade 50 KF Permendur, and three mag-
netostrictive ferrites (grades 21 SPA, F-38, F-42) under operating conditions
typical for acoustic radiators, i.e., with a bias magnetizing field intensity
$H_0 \approx (1.5-3)H_{opt}$ (H_{opt} corresponding to the maximum coupling coefficient K),
at an amplitude of mechanical stresses $\sigma_\sim$ up to a few hundred kgf/cm^2, and
at typical operating amplitudes of the magnetic induction $B_\sim$. The σ_0 level
was varied from 0 to 600-800 kgf/cm^2. The measurements were made with a
compound resonator so that specimens could be excited in the mode of free
resonant vibrations while under static compression. The measurements have
shown that, as σ_0 is increased, the Q-factor of all materials with negative
striction increases and the Q-factor of Permendur with positive striction de-
creases. Compressive stresses σ_0 increase the modulus of elasticity of all
materials with a high K (grade 42 ferrite and Permendur). As H_0 is increased,
Q and E are less affected by σ_0. The magnetostriction constant α of all
materials decreases monotonically under compressive stresses σ_0.

NOISE IMMUNITY OF A RICE HYDROACOUSTIC COMMUNICATION CHANNEL

SHUL'GIN, A. V.

[Text] The noise immunity of optimal incoherent reception of binary signals is
analyzed with a rice law of distribution of the transmission coefficient for
the sea, which takes into account that the statistical characteristics of
fluctuations of the acoustic vibration level depend on the depth and on the

distance. An approximate formula is derived for determining the mean error probability P with the coefficient of correlation between signal attenuation and noise attenuation limited to the 0-0.99 range. It is shown that P decreases fast with an increasing ratio of the regular component to the mean-squared value of the fluctuating component of the transmission coefficient for the sea, and also with an increasing coefficient of correlation between the two attenuations.

OL'SHEVSKIY, V. V.

[Text] The relation between the error of statistical measurements and the number of sample realizations is analyzed, with that error put in the form of the standard deviation of the estimate from the true probability characteristics. Such an analysis reveals that in dynamic acoustic experiments there is an optimum number of sample realizations which corresponds to the minimum error. It is shown that in an increasingly dynamic experiment the optimum number of sample realizations becomes smaller and the minimum error of statistical measurements becomes larger.

USSR   UDC 534-8

NOISE IMMUNITY OF A RAYLEIGH-TYPE HYDROACOUSTIC COMMUNICATION CHANNEL

SHUL'GIN, A. V.

[Text] A method is described by which the average error probability P in
optimal incoherent reception of binary signals can be determined and which
applies to the Rayleigh model of the transmission coefficient of the sea.
A simple approximate formula is derived for determining P, accurately within
10%, with the coefficient of correlation between signal attenuation and noise
attenuation limited to the 0-0.99 range. It is shown that P decreases fast
with an increasing coefficient of correlation between the two attenuations.

USSR   UDC 534-8

AN ENGINEERING DESIGN METHOD FOR THE SCAN TRAJECTORY OF THE BEAM OF A PLANE
RECTANGULAR ULTRASONIC ANTENNA ARRAY

DEDYUKHIN, A. S. and TOCHINSKIY, E. G.

[Text] A descriptive graphoanalytical method is proposed for determining
the values of the phase constants with respect to horizontal and vertical
lines of an equidistant-rectangular ultrasonic antenna array which will en-
sure that the scanning beam hits the target point within a given region.

USSR

FERROMAGNETIC SEMICONDUCTORS WITH GIANT BLUE SHIFT OF THE ABSORPTION EDGE

NAGAYEV, E. L., Physico-Technical Institute imeni A. F. Ioffe, Academy of
Sciences USSR

[Abstract] The anomalous giant blue shift of the optical absorption edge
observed in $CdCr_2S_4$ crystals with decreasing temperature is considered. An
interpretation of the effect is proposed, based on the predominance of inter-
band rather than intraband s-d exchange, resulting in virtual transitions of
electrons from the valence band to the conduction band. It is shown that
amplification of the effect is analogous to the intraband s-d exchange
mechanism responsible for the usual giant red shift of the absorption edge
ordinarily observed in ferromagnetic semiconductors with decreasing tempera-
ture. The blue shift should be observed in semiconductors where the s-d
exchange is weak in the conduction band. Some of the properties that set
these semiconductors apart from those with the ordinary red shift are dis-
cussed. In particular, it is shown that interband exchange does not cause
Zeeman splitting of the bands in the case of ferromagnetic ordering. Theory
also predicts the possibility of "antiferron" states in blue-shift semi-
conductors. These states act as inverse states with respect to the ferron
states of conduction electrons in antiferromagnetic semiconductors. In
degenerate ferromagnetic semiconductors with blue shift, indirect exchange
via conduction electrons should lead to a reduction of the Curie tempera-
ture. It is also possible that when the electron concentration falls below
that where ferromagnetic ordering becomes unstable, an energy advantage would
be realized in a nonhomogeneous state of the crystal where it dissociates
into alternating ferromagnetic and antiferromagnetic regions. In this case,
all conduction electrons would be concentrated in the antiferromagnetic
phase. References 5: 3 Russian, 2 Western.

USSR

DYNAMICS OF A ONE-DIMENSIONAL ELECTRON-PHONON SYSTEM AT LOW TEMPERATURE

BRAZOVSKIY, S. A. and DZYALOSHINSKIY, I. YE., Institute of Theoretical Physics imeni L. D. Landau, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] An investigation is made of the dynamic properties of a one-dimensional and quasi one-dimensional Fröhlich model in the region $T_c < T \leqslant T_{c0}$, where T_c is the true Peierls transition point, and T_{c0} is the transition point determined in the self-consistent field approximation. The permittivity, conductivity, density of electron states and dynamic structure factor are found. References 15: 6 Russian, 9 Western.

USSR

ACOUSTICO-OPTICAL PROPERTIES OF A NEMATIC CRYSTAL LAYER WITH HOMOGENEOUS ORIENTATION

KAPUSTINA, O. A. and LUPANOV, V. N., Acoustics Institute

[Abstract] The authors investigate acoustico-optical phenomena in thin layers of nematic crystals with homogeneous orientation. A thin layer of H-8 material (a mixture of MBBA and EBBA) was confined between a Mylar film transparent to sound 90 μm thick with a light-reflective coating, and an optically transparent glass plate 2 mm thick and 60 mm in diameter. Homogeneous orientation was achieved by a microrelief on the film. The experimental setup is shown in the figure.

The cell (1) was installed in the end face of a water-filled vessel (2) at
a distance of 200 mm from an acoustic emitter (3) with the sound-transparent
surface facing the emitter. The optical part of the installation consists
of a light source (4), a semitransparent mirror (5), polaroids (6,7) and a
photomultiplier (8). The output signal was registered by a chart recorder.
Shown at b in the figure is the coordinate system associated with the plane
of the layer in the cell. The position of the point of observation M is de-
termined by the radial angle θ measured from the normal (z-axis) to the plane
of the layer, and the azimuthal angle ϕ between the x-axis and the projection
on the xy-plane of radius vector R connecting the point of observation to
the coordinate origin. In the experiments the angle θ was varied over a
range of o-π/12, and angle ϕ took on the discrete values 0 and π/2. In the
light flux incident on the layer in the direction of the axis the electric
vector fluctuated along the x-axis. The layers studied had the initial ori-
entation of the long axes of the molecules directed along the x-axis or the
y-axis. The change in structure and optical characteristics of the layers
was studied with exposure to acoustic vibrations at 3.2 MHz. The results
show that a device can be made for representing acoustic information in real
time with an active element in the form of a nematic crystal layer with ho-
mogeneous orientation of the molecules, working on the effect of light
scattering. One of the main advantages of such a device is that the dimen-
sions of the active element are several hundred times the wavelength of ultra-
sound, which is important for recording acoustic holograms. References 3:
2 Russian, 1 Western.

USSR

NONLINEAR MAGNETOELECTRIC EFFECT IN FERROMAGNETIC SEMICONDUCTORS

GENKIN, G. M., Gor'kiy Scientific Research Radiophysics Institute

[Russian abstract provided by the source]

[Text] The author determines the intensity of magnetization of ferromagnetic semiconductors that is proportional to the square of the electric field in fields of the optical frequency band. It is shown that the effect is proportional to the energy of s-d-exchange interaction between carriers and magnetic atoms. The intensity of nonlinear magnetization for $\omega \gg \nu_F q$ is proportional to q^4 and n; when $\omega = 0$ it is proportional to q^2 and does not depend on n, where q and ω are the wave vector and frequency of nonlinear magnetization, and n is the carrier concentration. By subjecting a crystal to the action of two laser beams of the same frequency, a predetermined nonuniform static distribution of intensity of magnetization M_z was set up with magnitude and wave vector determined by the angle θ; q may vary over a wide range from 0 to 2_{ql} as the angle θ varies from 0 to π, where q_l is the wave vector of the light, θ is the angle between the directions of the laser beams. The distribution of magnetization intensity can be indexed with respect to the diffraction of the probe light; Estimates show that lasers of very low power are required to produce magnetization for which the intensity of the first diffraction maximum is of the order of the intensity of the probe light. Nonlinear magnetization leads to nonlinear interaction of waves in the optical band; generation of a difference frequency by a nonlinear ferromagnetic is considered. In contrast to known results of nonlinear optics, the mode of spatial synchronism is less effective when the difference frequencies do not exceed a certain value. References 23: 16 Russian, 7 Western.

USSR

'COMPRESSION' OF THE ELECTRON SHELL OF A NEUTRAL ATOM BY A CRYSTAL MATRIX

OVECHKINA, YE. YE., ROMANOV, V. P., ZABRODSKIY, YU. R. and KOSHKIN, V. M.,
Physico-Technical Institute of Low Temperatures, Academy of Sciences UkrSSR

[Russian abstract provided by the source]

[Text] The method of nuclear gamma-resonance is used to study the electron
state of tin impurity atoms in a Ga_2Te_3 crystal matrix. It is shown that
tin impurity atoms in loose structures of the Ga_2Te_3 type are in the union-
ized atomic state, and that compression of the electron shell of these atoms
in the crystal matrix leads to an appreciable increase of the charge density
on Sn^{119} nuclei. A simple quantum-mechanical model is proposed that accounts
for the change in density of s-electrons on the nucleus of an atom located
in a spherical cavity with infinitely high potential walls. By using this
model, one can determine the crystal-chemical radii of the interstitial im-
purity atoms in the lattice from data on the isomeric nuclear gamma resonance
shift alone. Estimates are given for the radius of a tin impurity atom in
a matrix of the Ga_2Te_3 type. References 9: 7 Russian, 2 Western.

USSR

CURRENT FLUCTUATIONS IN SEMICONDUCTORS IN A QUANTIZING ELECTRIC FIELD

ROZHKOV, S. S. and TOMCHUK, P. M., Institute of Physics, Academy of Sciences
UkrSSR

[Abstract] Current fluctuations are calculated in semiconductors in a strong
electric field such that quantum effects caused by the development of "Stark
levels" begin to influence electron behavior. In previous articles by P. M.
Tomchuk and A. A. Chumak [Preprint, Institute of Physics, Academy of Sciences
UkrSSR, No 9, 1971; Ukrainskiy fizicheskiy zhurnal, Vol 18, No 10, 1973;
Ukrainskiy fizicheskiy zhurnal, Vol 18, No 11, 1973] a method of calculating
fluctuations was proposed, based on equations of motion for the quantum ana-
log of the microscopic distribution function. By this technique, extraneous
sources of fluctuations can be introduced into the equation for the fluctuat-
ing part of the distribution function without any assumptions other than
those used in deriving the corresponding kinetic equations. In this paper
the authors use this method to calculate spatially homogeneous fluctuations

in current transverse to a strong electric field. The analysis applies to
both high and low frequencies. It is shown that Stark quantization apprecia-
bly changes the nature of fluctuations with intensity that can appreciably
exceed that of equilibrium fluctuations. The investigated fluctuations are
dependent on the parameters of the scattering system and the width of the
energy band, leading to definite conclusions as to the nature of dissipation
and the band structure of the semiconductor. The simplicity of the results
compensates to a considerable extent for experimental difficulties. It is
pointed out that the problem of linear response is solved in this paper, and
the results can be used in problems where a strong constant field is accom-
panied by a weak variable electric field. References 10: 7 Russian, 3
Western.

HIGH-FREQUENCY CONDUCTIVITY OF IONIC SEMICONDUCTORS AT LOW TEMPERATURES

EPSHTEYN, E. M.

[Russian abstract provided by the source]

[Text] The author calculates the rf conductivity of a semiconductor when
electrons are scattered by optical phonons where $\hbar\omega_0 \ll kT$ (ω_0 is optical
phonon frequency, T is temperature). It is shown that even in the classi-
cal frequency region ($\hbar\Omega \ll kT$, where Ω is field frequency) the Drude equa-
tion may lead to incorrect frequency dependence and even to incorrect order
of magnitude of rf conductivity. References 7: 6 Russian, 1 Western.

USSR

THE VIBRATIONAL SPECTRUM OF GaTe

BELEN'KIY, G. L., ALIYEVA, L. N., NANI, R. KH., SALAYEV, E. YU., and SHTEYN-
SHRAYBER, V. YA., Institute of Physics, Academy of Sciences Azerb SSR, Baku

[Abstract] The reflection and transmission spectra of GaTe single crystals
grown by the Bridgman technique were studied in the wave number range of
$300-100$ cm^{-1} on the FIS-3 spectrophotometer with resolution of at least 4 cm^{-1}
in polarized light. The positions of reflection maxima correlate with the
transmission spectrum. The frequencies of longitudinal and transverse
phonons are calculated from the reflection spectra by standard Kramers-
Kronig analysis. These frequencies are summarized in a table together with
the positions of transmission bands, permittivities and also indices of re-
fraction for light polarized variously relative to the b-axis. The results
confirm group-theoretical calculations that there should be twice as many
infrared-active modes for light polarized with the electric vector perpen-
dicular to the b-axis than for the case of parallel polarization. References
7: 2 Russian, 5 Western.

USSR

EXCITATION OF ACOUSTIC PLASMONS IN BISMUTH

BABKIN, G. I. and KRAVCHENKO, V. YA., Institute of Solid State Physics,
Academy of Sciences USSR

[Abstract] Previous research on acoustic plasmons has been impeded both by
the requirements for high-quality specimens ($\omega\tau \gg 1$) and by the weakness of
the effects by which wave excitation can be judged. For instance the stimu-
lation of acoustic plasmons by an alternating electric field normal to the
surface of a bismuth plate is limited by screening. The authors suggest
other methods of stimulating plasma sound. Under skin-effect conditions, a
change of concentrations at the surface can be induced that will then propa-
gate into the body of the specimen. This can be achieved by anisotropy, for
instance by using bismuth specimens in which the third-order axis C_3 makes
a small angle θ with the normal. A weakly damped concentration wave will
carry the perturbation to the other side of the plate; because of anisotropy,
a field will arise parallel to the surface that will continue outward in the
form of an electromagnetic wave. Perturbation of concentration with the
skin effect can also take place under the action of crossed electric and

magnetic fields of an electromagnetic wave. In this case an acoustic plasma wave goes through the specimen on twice the frequency. Anisotropy can be used to transform this wave and couple it out of the specimen in the form of a transverse electromagnetic wave. Calculations are given showing the effectiveness of these techniques for stimulated emission of acoustic plasmons. The results of the calculations show that detection of acoustic plasmons from the effects of transmission of electromagnetic waves through a bismuth plate is experimentally feasible. References 8: 5 Russian, 3 Western.

USSR

MAGNETIC RESONANCE LINE WIDTH IN A DILUTE PARAMAGNETIC .

KOCHELAYEV, B. I., SABIROV, R. KH., and KHALIULLIN, G. G., Kazan' State University imeni V. I. Ul'yanov-Lenin

[Russian abstract provided by the source]

[Text] The authors propose a theory of magnetic resonance line broadening due to two-particle interactions in an extrinsic paramagnetic with consideration of the difference in probabilities of filling of sites of different coordination spheres. This difference, which is particularly important in the case of interactions that fall off rapidly with distance, leads to an appreciable change both in the statistical theory of Anderson, and in the Kittel-Abrahams theory that is based on the method of moments. In particular, the width of a dipole-dipole broadened line in the approximation of the cutoff Lorentzian shape function depends on concentrations almost quadratically, rather than linearly. The problem of the form of the correlation function is discussed for the longitudinal component of electron spin in a diamagnetic with a paramagnetic impurity. This function enters into the expression for the rate of nuclear relaxation due to the magnetic ion. The proposed theory agrees well with experimental results. References 14: 7 Russian, 7 Western.

USSR

SPECIFICS OF REFLECTION OF SLOW ELECTRONS FROM CLEAN FACES (111) of Si AND
(110) of GaAs

NESTERENKO, B. A., and BORODKIN, A. D., Institute of Semiconductors, Academy
of Sciences UkrSSR, Kiev

[Russian abstract provided by the source]

[Text] The method of diffraction of slow electrons is used to study atomic-
ally clean surfaces (111) of silicon and (110) of gallium arsenide. The in-
ternal potential of these crystals is found to be 9 ± 2 eV for Si and $15 \pm$
2 eV for GaAs. It is found that the interplanar spacing for the surface
coincides within 5% with the spacing in the crystal body for the depth of
penetration of slow electrons ($\sim 10^{-7}$ cm). It is established from measure-
ments of the temperature and energy dependences of the Bragg maxima that
inelastic scattering of electron waves is based on the mechanism of electron-
electron interaction of primary emission with the investigated semiconductors.
References 13: 3 Russian, 10 Western.

USSR

A NEW PHASE TRANSITION IN LEAD ZIRCONATE-TITANATE

ISHCHUK, V. M., MOROZOV, YE. M., and KLIMOV, V. V.

[Abstract] Processes of disordering in lead zirconate-titanate are studied.
Both polycrystalline and single crystal specimens were investigated with
composition $PbZr_{1-x}Ti_xO_3$ ($0 < x \leqslant 0.5$). The results show anomalous properties
in the paraelectric phase due to a phase transition of the first kind. It is
suggested that the results can be interpreted by the Comes-Lambert-Guinier
model in which it is assumed that cations are displaced in direction (111)
within the limits of chains comprising 20-40 elementary cells. In the ferro-
electric state the chains are oriented throughout the crystal, but in the
cubic modification disordering occurs and the crystal does not show spontane-
ous polarization. The temperature dependence of polarization confirms this
hypothesis. References 5: 1 Russian, 4 Western.

USSR

THE PHOTOACOUSTIC EFFECT IN GERMANIUM AND SILICON CRYSTALS

DURGARYAN, A. A. and FAKHEM, M. A., Yerevan State University

[Russian abstract provided by the source]

[Text] The temperature dependence of the phtoacoustic effect in n-Ge cry-
stals is studied by the method of damping of free flexural vibrations on
1-8 kHz. The study showed that the reduction in the absorption of ultra-
sound under the effect of exposure to light (0.02 W/cm^2) is of the order
of 35% in the temperature range from 20 to 500°C. An estimate is made of
the way that the magnitude of the photoacoustic effect depends on the dura-
tion of exposure in n-Ge and n-Si crystals. The mechanism of the photo-
acoustic effect is considered as stimulated emission of coherent phonons by
"hot" photoelectrons in the presence of an acoustic field. References 17:
13 Russian, 4 Western.

USSR

ON A THEORY OF INTERACTION OF AN IMPURITY CENTER WITH AN EXTERNAL ELECTRIC
FIELD

KORIYENKO, A. A. and YEREMIN, M. V., Kazan' State University

[Abstract] Paramagnetic centers formed by interstitial atoms of transition
metals in a regular crystal lattice are readily polarized by an applied ex-
ternal electric field. In the case of ionic and electronic mechanisms of
polarizability, the principal factor is the crystal field of odd parity that
admixes excited states of opposite parity into the states of the main con-
figurations of ions of the impurity center. In this paper the authors con-
sider another effective mechanism of interaction of an impurity center with
an electric field. This mechanism involves the existence of a specific
"exchange" dipole moment of the impurity center that arises as a consequence
of asymmetry in the overlap between the electron orbits of the metal and
ligands. It is shown how consideration of the exchange dipole alters the
classical Judd-Ofelt theory of electronic polarizability. The analysis is
based on $Al_2O_3:Cr^{3+}$ and $LaF_3:Er^{3+}$. References 16: 11 Russian, 5 Western.

25

STIMULATED EMISSION OF ACOUSTIC HARMONICS IN A LAMINAR STRUCTURE MADE UP OF A PIEZOELECTRIC AND A POLYCRYSTALLINE LAYER OF CdS

SEREYKA, A. P. and MIL'KYAVICHENE, Z. A., Vil'nyus State University imeni
V. Kapsukas

[Russian abstract provided by the source]

[Text] An experimental study was done on the influence that the nonlinear
properties of a polycrystalline layer of CdS applied to the surface of YZ
LiNbO$_3$ have on stimulated emission of the second and third acoustic harmonics
at an input signal frequency of 10 MHz. An external electric field was used
to control the nonlinearity of the layer due to electric-field dependence of
intercrystalline barriers. In contrast to concentration nonlinearity, this
type of nonlinearity leads to formation of a third acoustic harmonic and
alters the resistance of the layer. References 10: 5 Russian, 5 Western.

INVESTIGATION OF ELECTRON TRAPS IN CdInGaS$_4$ SINGLE CRYSTALS

ABDULLAYEV, G. B., AGAYEV, V. G., MAMEDOV, N. D., NANI, R. KH., and SALAYEV,
E. YU., Institute of Physics, Academy of Sciences Azerb SSR, Baku

[Abstract] Trap centers in the forbidden band were studied in single cry-
stals of CdInGaS$_4$ by analysis of current-voltage curves under conditions of
space-charge limited current and thermostimulated conductivity in strong
electric fields. The crystal specimens were grown by chemical transport
reaction and had a dark resistivity of about $10^8 \, \Omega \cdot$cm at 300 K. Space-
charge limited current measurements were made along the C axis at 120-350 K
on specimens from 10 to 150 µm thick. In-Ga contacts had the best injecting
properties. The thermostimulated conductivity measurements were made per-
pendicular to the C axis on specimens with indium contacts. The specimens
were cooled in the dark to liquid nitrogen temperatures and then exposed to
natural light. After terminating exposure, an electric field of about $1.2 \cdot
10^4$ V/cm was applied to the specimen. After reaching an equilibrium state,
the specimen was heated at a constant rate of 0.3 K/s. The current-voltage
characteristics at all investigated temperatures show two sections with an
abrupt rise in current, and the slope of these curves decreases with rising
temperature. The sections with steeply rising current are attributed to two

groups of electron traps in the forbidden band. The traps lie at levels of
0.2-0.22 eV and 0.12-0.13 eV with concentrations of 10^{16} cm^{-3} and 10^{17} cm^{-3}
respectively. The capture cross sections are 10^{-21} and 10^{-22} cm^2 respective-
ly. Calculations of trap parameters by space-charge limited current and
thermostimulated conductivity agree. Electron mobility in $CdInGaS_4$ single
crystals is nearly independent of the applied electric field up to about
$2 \cdot 10^4$ V/cm. Figures 4; table 1; references 10: 3 Russian, 7 Western.

CURRENT CONTROL OF NEGATIVE RESISTANCE IN REVERSE-BIASED GaAs DIODES

BRODOVOY, V. A., KORONKEVICH, V. N., and PEKA, G. P., Kiev State University
imeni T. G. Shevchenko

[Russian abstract provided by the source]

[Text] An investigation is made of the switching effect accompanying an
avalanche breakdown of reverse-biased pn junctions and Schottky diodes made
from gallium arsenide. It is shown that with reverse biasing across the
diode there is a transition to the low-resistance state at a certain voltage
which is equal to the activation voltage (S-shaped static current-voltage
curves). Switching is attributed to the fact that the space charge of im-
purities in the pn junction or depletion layer is compensated by the charge
of the free carriers during an avalanche breakdown. An examination is made
of the kinetics of the effect. The experimentally observed switching delay
of 250 μs-125 s (depending on the bias voltage) is due to field ionization
of impurities in the vicinity of the pn junction. Figures 5; references 13:
5 Russian, 8 Western.

ENERGY BAND STRUCTURE AND TWO-PHONON ABSORPTION IN $CdGa_2S_4$ AND $CdGa_2Se_4$
CRYSTALS

RADAUTSAN, S. I., SYRBU, N. N., NEBOLA, I. I., TYRSIU, V. G., and BERCHA,
D. M., Kishinev Polytechnical Institute imeni S. Lazo

[Russian abstract provided by the source]

[Text] An investigation is made of the anisotropy of edge absorption and
reflection spectra in the region $h\nu > E_g$, and two-phonon absorption in the
range of 400-1000 cm^{-1}. A theoretical examination is made of electron
transitions and processes of two-phonon absorption. A band structure is
suggested and discussed at k = 0, and the symmetry of some one-phonon ab-
sorption bands is determined. Figures 5; tables 3; references 5 (Russian).

PHOTON TRANSFER OF EXCITATION OF NONEQUILIBRIUM CHARGE CARRIERS IN GALLIUM
ARSENIDE

YEPIFANOV, M. S., GALKIN, G. N., BOBROVA, YE. A., and VAVILOV, V. S., Physics
Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Abstract] The radiation transport approach is used for computer calcula-
tions of the depth profile of nonequilibrium charge carrier distribution in
undoped epitaxial films of gallium arsenide when the energy distribution of
the carriers is boltzmanian. Excitation intensity is assumed to be high.
Carrier distribution by depth is found to be closer to linear than to ex-
ponential, as would be the case for ordinary diffusion. The calculations
are compared with experiments using a ruby laser with emission pulse of 40
ns duration and excitation level of $10^{21}-10^{24}$ $cm^{-2} \cdot s^{-1}$. The observed agree-
ment on recombination emission and absorption on nonequilibrium charge car-
riers confirms the predominance of photon transfer of excitation calculated
in previous studies. Figures 3; references 4: 2 Russian, 2 Western.

FORMATION OF LOW-RESISTANCE n-LAYERS ON p-InSb BY PULSED LASING

BOGATYREV, V. A., and KACHURIN, G. A., Institute of Semiconductor Physics,
Siberian Department, Academy of Sciences USSR, Novosibirsk

[Russian abstract provided by the source]

[Text] Low-resistance n-layers up to 5 μm thick with concentration of free
electrons of the order of 10^{18} cm^{-3} and effective mobility of up to $1.8 \cdot 10^4$
$cm^2/V \cdot s$ (77 K) are formed on the surface of p-InSb by bombardment with
laser pulses lasting 10^{-8} and $5 \cdot 10^{-3}$ s. The donor centers introduced by
laser exposure are stable up to an annealing temperature of 375-400°C.
The possible nature of the donors is analyzed. It is concluded that their
formation is associated with structural changes that occur as a result of
quenching. References 9: 5 Russian, 4 Western.

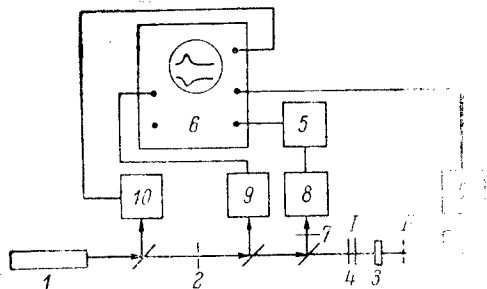# MEASUREMENT OF TWO-PHOTON ABSORPTION IN GaS_xSe_{1-x}

BOBROVA, YE. A., VAVILOV, V. S., GALKIN, G. N., YEPIFANOV, M. S., MEKHTIYEV,
R. F., and SAFAROV, V. G., Physics Institute imeni P. N. Lebedev, Academy of
Sciences USSR, Moscow, Azerbaydzhan State University imeni S. M. Kirov, Baku

[Abstract] On the basis of direct measurements, the coefficients of two-
photon absorption were determined in GaS_xSe_{1-x} plane-parallel crystals 0.04-
0.16 cm thick. The experimental arrangement is shown in the figure.

Ruby laser 1 was operated in the Q-switched mode. Pulse duration was about
40 ns. Diaphragm 2 isolated a section of the light beam with approximately
constant emission density with respect to the cross section. The specimens

3 were exposed to radiation in direction (001) perpendicular to the surface. A set of attenuating glass filters 4 was placed in front of the specimens. Nonlinearity of these filters was less than 0.5% up to 5 MW/cm^2. The signals from the two coaxial photocells 8 were expanded by peak detectors 5 and fed to the balance inputs of oscilloscope 6. The amplitudes of the detector signals were equalized by compensating filters 7, after which the attenuating filters were moved from position I in front of the specimen to position II behind it. This changed the intensity of the incident radiation from about 0.5 to about 3 MW/cm^2. From the imbalance, the nonlinearity of absorption in the specimen was determined. Photocell 9 was used for checking the amplitude of the laser pulse, and photodiode 10 was for triggering the oscilloscope. The coefficient of two-photon absorption β was calculated from the expression

$$\frac{S_0}{S_d}\frac{(1-R)^2}{e^{\alpha d}}=1+\frac{\beta(1-e^{-\alpha d})(1-R)}{\alpha}S_0$$

where S_0 and S_d are the emission intensities preceding and following the specimen respectively, R is reflectance, α is the coefficient of linear absorption and d is the thickness of the specimen. The values of β for GaS_xSe_{1-x} with x = 0, 0.2, 0.5 and 0.8 stay within a range of 0.08-0.65 cm/MW. References 3; table 1; references 8: 6 Russian, 2 Western.

CALCULATION OF THE MOBILITY OF ELECTRONS IN EPITAXIAL n-GaAs

KOZEYKIN, B. V., FROLOV, I. A., and VYSOTSKIY, S. A.

[Abstract] Electron mobility in epitaxial n-GaAs is analyzed with consideration of thermal lattice vibrations of the ionized impurity and additional scattering centers in accordance with the function

$$\mu = \mu(N_d, N_a, A, p, T), \qquad\qquad (1)$$

where N_d, N_a are the concentrations of electron donors and acceptors, T is temperature, and the coefficients A, p describe additional scattering

$$\mu_{add.} = AT^p. \qquad\qquad (2)$$

Computer optimization of (1) from experimental data has shown that the parameter p varies from -1.5 to 0.5. It can be assumed that additional scattering is due to at least two types of centers, and that the proportion between these centers determines the value of p. One type of center might be space-charge regions. With consideration of space-charge limited mobility and the temperature dependence of the space-charge scattering cross section, the limits of variation of the exponent p in (2) are between -1.5 and -0.5, which is in agreement with experimental data. A component of additional

mobility corresponding to scattering by an unshielded dipole with $p = 0.5$ is observed in all specimens. Expressions are derived for the concentration, mean square of the scattering length and scattering parameter for dipoles at a fixed temperature. Analysis of experimental data in accordance with the proposed formulas gives a concentration of space-charge regions of $(3-11) \cdot 10^{14}$ cm^{-3}, and a "geometric" size of 50-300 Å. This is in agreement with the data in the literature. Figure 1; references 9: 3 Russian, 6 Western.

LUMINESCENCE POLARIZATION OF CdGeP$_2$ CRYSTALS

RUD', YU. V., and MAL'TSEVA, I. A., Physico-Technical Institute imeni A. F. Ioffe, Academy of Sciences USSR, Leningrad

[Abstract] A report on experiments with CdGeP$_2$ crystals aimed at observing anisotropy of crystal properties in edge recombination emission. The specimens showed edge recombination emission spectra normal to the excited natural surface of the crystals with index (112). Steady-state photoluminescence was stimulated by He-Ne laser emission. The measurements were made at 4.2 and 77 K. It was found that luminescence is polarized in accordance with crystal symmetry, and in fact that the anisotropy of emission of the crystals is completely determined by the anisotropy of the crystal lattice field. It is concluded that emission of LED's and semiconductor lasers based on crystals of ternary compounds $A^{II}B^{IV}C_2^V$ should be linearly polarized. The authors thank Yu. K. Undalov for furnishing the crystals. References 11: 9 Russian, 2 Western.

ELECTRO-OPTICAL HYSTERESIS AND CRITICAL BEHAVIOR OF THE ELECTRO-OPTICAL
PROPERTIES OF CRYSTALS OF THE TRIGLYCINE SULFATE FAMILY

IVANOV, N. R., BENDERSKIY, S. YA., and SHUVALOV, L. A., Institute of Crystal-
lography, Academy of Sciences USSR

[Abstract] The induced deformation electro-optical effect is studied in
ferroelectric crystals of the triglycine sulfate family and their solid so-
lutions by a modified dynamic technique with application of a weak alternat-
ing measurement field, enabling deep penetration into the critical phase
transition region. Differential electro-optical hysteresis loops are
plotted for these crystals, from which the critical indices are found for the
quadratic and linear electro-optical effects. The results agree completely
with the predictions of thermodynamic theory. It is shown that deformation
corrections may play a very important part for crystals with a large natural
birefringence. In particular, because of the strong electrostriction de-
formation along the Z axis, the correction for the electro-optical coeffi-
cient measured on a z-cut is about the magnitude of the coefficient itself
for all crystals of the triglycine sulfate family. For this reason, the
values given in the literature for the electro-optical coefficients of this
family should be re-examined in the light of the results of this research.
On the other hand, it is shown that there is a promising outlook for practi-
cal use of crystals in which high natural birefringence is combined with a
large piezoelectric or electro-optical effect in the direction of propaga-
tion of light. References 20: 15 Russian, 1 Czech, 4 Western.

ACOUSTIC ACTIVITY AND OTHER EFFECTS DUE TO SPATIAL DISPERSION IN CRYSTALS

VUZHVA, A. D., and LYAMOV, V. YE., Moscow State University imeni M. V. Lomonosov

[Russian abstract provided by the source]

[Text] Equations of state are derived for a piezoelectric crystal with consideration of spatial dispersion. Effects are described that arise in propagation of acoustic and electromagnetic waves with consideration of the piezoelectric effect and its spatial dispersion. The particulars of generation of harmonics in acoustically active crystals are discussed. Matrices are given for a tensor that describes elastic spatial dispersion (tensor of acoustic activity) for all crystallographic classes. References 16: 7 Russian, 9 Western.

INVESTIGATION OF GROWTH KINETICS AND POLYTYPICISM OF EPITAXIAL LAYERS OF SILICON CARBIDE GROWN FROM THE GAS PHASE

LILOV, S. K., SAFARALIYEV, G. K., TAIROV, YU. M., and TSVETKOV, V. F., Leningrad Electric Engineering Institute

[Abstract] The structure of epitaxial layers of silicon carbide grown from the vapor phase was studied by diffraction of x-rays incident at small angles to the surface of the epitaxial films, and also by luminescence, enabling definite determination of polytypic structure. The films were grown by the sandwich technique, both the vapor source and substrates being single-crystal plates of silicon carbide with polytypes 3C, 15R, 21R, 27R, 4H and 8H. Growing was done on chemically etched faces (0001) Si and (0001) C, and also on planes deviating from (0001) by an angle α = 0.4-15°. The epitaxial layers were grown in vacuum and low-pressure argon. It was found that the limiting stage of the growth process below 10 mm Hg is diffusion mass transfer in the gas phase, while above 10 mm Hg the limiting stage is heterogeneous reactions on interfaces. In the region of heterogeneous surface reactions, growth rate showed the same dependence on α as has been observed in growing other semiconductor crystals; growth rate is independent of α in the diffusion region. Structural studies showed complete reproducibility of the film-substrate polytype. The layers apparently grow by tangential displacement of series of parallel steps. References 5: 3 Russian, 2 Western.

INVESTIGATIONS OF SHORT-RANGE ORDER IN MELTS OF SEMICONDUCTOR COMPOUNDS OF SYSTEMS A^{III}-B^{VI}

POLTAVTSEV, YU. G.

[Russian abstract provided by the source]

[Text] A report on the results of radiographic studies of molten InTe, In_2Te_3, Tl_2Se and Tl_2S. It is shown that the structure of short-range order of the melts, like that of the crystals, is different. It is established on the example of InTe that during melting of compounds of equiatomic composition having type TlSe crystal structure there is a considerable change in packing of atoms. Compounds $A_2^{III}B_3^{VI}$ and Tl_2B^{VI} show some retention of the packing of atoms typical of crystals when they are in the molten state. References 12: 10 Russian, 2 Western.

MAGNETOPOLASMA RESONANCE IN ELECTRON-HOLE DROPS IN GERMANIUM ON CIRCULARLY POLARIZED SUBMILLIMETER WAVES

GAVRILENKO, V. I., KONONENKO, V. L., MANDEL'SHTAM, T. S., and MURZIN, V. N., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Abstract] The authors study cyclotron resonance spectra of free carriers and magnetoplasma resonance spectra in electron-hole drops in germanium. The spectra were investigated on circularly polarized submillimeter waves: 2.06 mm wavelength corresponding to quantum energy of about 0.6 MeV, and 0.61 mm wavelength corresponding to about 2 MeV. The magnetic fields were parallel to (111) with field strengths up to about $2 \cdot 10^6$ A/m. The carriers in the crystal were optically pumped, and the measurements were made at 4.2-1.6 K. The degree of ellipticity of polarization was about 5% for the low-energy quanta, and about 15% for the higher energy. At 4.2 K the cyclotron resonance spectra show lines corresponding to free electrons for one direction of polarization, and lines corresponding to holes for the opposite direction in the case of low-energy quanta. With an increase in energy, one of the lines changes from "electron polarization" to "hole polarization," which agrees with quantum theory of cyclotron resonance of carriers in germanium since transitions should take place between the lower Landau levels

of the valence band of the type $2_0 \rightarrow 1_1$. When the temperature is reduced to 1.8 K where phase transition of excitons to the condensed state takes place, the spectra show lines due to magnetoplasma resonance in electron-hole drops. The polarization and temperature behavior of these lines confirms the model of magnetoplasma resonance in electron-hole drops, which justifies the use of this model in determining the effective masses of carriers in the condensed phase, studying changes in the equilibrium concentration of particles in electron-hole drops and in similar theoretical problems. The authors thank Academician B. M. Vul and N. A. Irisova for interest in the work, and also Ye. A. Vinogradov and G. V. Kozlov for constructive criticism and assistance. Figures 3; references 11: 7 Russian, 1 Polish, 3 Western.

PARAMETRIC INTERACTIONS IN STRONTIUM TITANATE DIELECTRIC MICROWAVE RESONATORS AT 78 AND 4.2 K

IVANOV, I. V., BELOKOPYTOV, G. V., and SYCHEV, V. M., Moscow State University, Vibration Physics Department

[Abstract] It is shown that strontium titanate is a suitable nonlinear dielectric for a transmission-line resonator section that can be tuned to optimum nonlinearity and three-frequency synchronism. The nonlinear properties of this material are especially pronounced at liquid helium temperatures. Experiments are done with two types of strontium titanate resonators at 78 and 4.2 K. Resonators with silver electrodes were studied at 78 K in the transverse mode far from the self-excitation threshold. Parametric amplification of signals with power of the order of 10^{-10} W was observed at pumping power in the mW range. The system operated in the nondegenerate mode. Niobium electrodes were used on flat resonators at 4.2 K. The storage factor was low, and pumping power in the 1 GHz frequency range was of the order of a few hundred mW. The low-Q resonators also had low impedance, making for poor coupling with the signal source and a narrow differential between pumping levels corresponding to the amplification threshold and the parametric self-excitation threshold. Half-frequency stimulated emission was observed in one case, but deteriorated with continued operation. Figures 2; references 9: 8 Russian, 1 Western.

INVESTIGATION OF THE COHESIVENESS AND MORPHOLOGY OF METAL COATINGS ON
WHISKERS

SIDEL'NIKOV, V. K., and ANDREYEVA, L. N.

[Russian abstract provided by the source]

[Text] A study is done on the strength of adhesion of nickel coatings to
a sapphire substrate as a function of the thickness of the metal layer and
the annealing temperature. A heat treatment program is worked out in which
the nickel coatings are not damaged. To increase the strength of adhesion
of the metal to the sapphire, optimum heat treatment conditions are estab-
lished. In studying the morphology of the nickel coating on sapphire, a criti-
cal annealing temperature is found above which the coatings are destroyed.
References 5 (Russian).

GALVANOMAGNETIC PROPERTIES OF MICROWIRES MADE FROM ALLOY BASED ON INDIUM
ANTIMONIDE

BUGAKOV, V. I., GITSU, D. V., DOLMA, V. A., IOYSHER, A. M., KOTRUBENKO, B. P.,
and LAPTEV, A. V.

[Abstract] An analysis of the data in the literature indicates that the
magnetoresistance $\Delta\rho/\rho$ of indium antimonide microwire should increase when
semimetal dopants are added. The authors studied some electrophysical param-
eters of microwires made from indium antimonide doped with bismuth and InBi.
A technique was developed for making microwires from $(InSb)_{1-x}Bi_x$ and (InSb)
$_{1-x}(InBi)_x$ of different diameters. The wire was cast from the liquid phase
in an inert atmosphere. Measurements were made by the conventional compensa-
tion method. Magnetoresistance was increased sharply by the addition of up
to 0.5% InBi to InSb. Magnetoresistance is approximately linearly dependent
on induction for these wires in fields of 0.3-3 T. With higher concentra-
tions of InBi, saturation of magnetoresistance is observed in fields strong-
er than 1 T. Curves for magnetoresistance as a function of composition show
two relative maxima: at 0.5% and 3% InBi, and at 0.5% and 10% Bi. The
bismuth-doped wire shows a stronger increase in magnetoresistance. This is
attributed to highly mobile and strongly anistropic charge carriers, and to
strong anisotropy of electron and hole mobility in the bismuth phase. The

doped microwires show "anomalous" behavior of magnetoresistance with tempera-
ture: at low temperatures the magnetoresistance is lower than at room tem-
perature. Curves are given showing the increase in thermoelectromotive
force and reduction in resistivity of the doped wires with increasing tem-
perature. It is found that the forbidden band is narrower than for massive
pure InSb. X-ray phase analysis shows that a second phase appears in micro-
wire containing more than 2-3% of either dopant. The components of the al-
loys show periodic distribution lengthwise of the wire. In comparison with
massive galvanomagnetic elements, the doped microwires have the decided ad-
vantage of linear dependence on magnetic induction over a wide range of
fields. The increase in magnetoresistance with rising temperature should
also be of practical use. References 7: 4 Russian, 3 Western.

INDIRECT EXCITONS IN GALLIUM SELENIDE

ABDULLAYEV, G. B., academician, BELENK'KIY, G. L., NANI, R. KH., SALAYEV, E.
YU., and SULEYMANOV, R. A., Institute of Physics, Academy of Sciences Azerb
SSR

[Abstract] The paper gives the results of investigations of the absorption
and differential absorption spectra of single crystal GaSe when the electric
vector of the incident radiation is polarized parallel and perpendicular to

C. The spectra $\frac{1}{J} \cdot \frac{dJ}{d\lambda}$ (J is the transmission of the specimen) were studied

by using the DFS-12 spectrometer with resolution of at least 5 Å. A glass
plate was used for frequency modulation of the light with depth of modula-
tion of 4 Å. The measurements were made at different temperatures from 4.2
to 300 K. The results indicate that absorption of light at energies below
1.96 eV at 300 K is due to indirect exciton transitions with parallel polari-
zation of the incident electric vector. It is calculated that the indirect
exciton band in GaSe lies at 2.062 eV at 4.2 K. References 6: 3 Russian,
3 Western.

USSR

ELECTRON AND POSITRON BREMSSTRAHLUNG SPECTRA WITH ENERGY OF 1 GeV IN CRYSTALS
OF SILICON, GERMANIUM AND NIOBIUM

GRISHAYEV, I. A., KOVALENKO, G. D., and SHRAMENKO, B. I., Khar'kov Physico-
Technical Institute, Academy of Sciences Ukrainian SSR

[Russian abstract provided by the source]

[Text] The authors measured the 1 GeV electron and positron bremsstrahlung
spectra. They found that for silicon, niobium and gemanium crystals when
the condition of axial canalization is satisfied there is a substantial
difference in the measured cross sections of the electron and positron
bremsstrahlung. The experimental values for the positrons are less than
those computed in the Born approximation, whereas those for electrons are
greater. If the condition of plane canalization is satisfied a distinction
between theory and experiment for silicon and germanium crystals is ob-
served only for positrons; for electrons the agreement between theory and
experiment is observed in the entire energy range with the exception of the
coherent maximum range for germanium and niobium crystals. Figures 7;
table 1; references 18: 10 Russian, 8 Western.

USSR

MOTION OF CHARGES IN CRYSTALLINE HELIUM

KESHISHEV, K. O., Institute of Physical Problems, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] For the purpose of determining the charge carrier mobility in cry-
stalline helium the author investigated the diode volt-ampere characteristics
and temperature dependences of the current induced by a tritium source. He
demonstrated that the current in the diode is proportional to the square of
the voltage in a comparatively small range of voltages and temperatures. In
the region of high voltages the shape of the volt-ampere characteristics is
determined by the dependence of the charge drift velocity on the electric
field strength. The author uses a three-electrode time-of-flight method
for direct measurement of the drift velocity. He measures the temperature
dependences of the positive and negative charge carrier mobility in differ-
ent molar volumes and the dependence of their drift velocity on the electric

field strength. The obtained data are compared with the results of available theoretical works. Figures 19; references 20: 9 Russian, 11 Western.

USSR

RESISTANCE OF PURE Al AND WEAK SOLUTIONS OF Mg, Zn and Ga IN Al IN THE 2-40 K RANGE

KHLOPKIN, M. N., PANOVA, G. KH., and SAMOYLOV, B. N. (deceased), Institute of Atomic Energy imeni I. V. Kurchatov

[Russian abstract provided by the source]

[Text] The authors made an experimental investigation of the temperature and concentration dependences of the electrical resistance and transverse magnetic resistance of polycrystalline aluminum and weak solutions of magnesium, zinc and gallium in aluminum at 2-40 K in magnetic fields up to $4 \cdot 10^6$ A/m. They observed a deviation from the Matthiessen rule and an anomalous behavior of the magnetic resistance. They found that the magnetic resistance depends on the type of impurity atoms and has a nonmonotonic temperature behavior. They demonstrated that the observed anomalies can be explained by the anisotropy of scattering by phonons and impurity atoms. Figures 6; table 1; references 15: 8 Russian, 7 Western.

USSR

LOW-TEMPERATURE PHOTOLUMINESCENCE OF GALLIUM ARSENIDE

STOPACHINSKIY, V. B., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The author studies the emission spectra of gallium arsenide with various amounts of impurities at low temperatures in a wide range of excitation levels. He demonstrates that the dominant channel for recombination of free excitons is the capture on shallow donors and acceptors with subsequent very fast annihilation of exciton-impurity complexes. When the

excitation density is raised to $n_{cr} \sim 10^{15}$ cm^{-3} there is a condensation of the free carrier gas into electron-hole drops with equilibrium density of $n_o \sim 10^{16}$ cm^{-3}. Figures 7; table 1; references 15:   7 Russian, 8 Western.

EXCITATION OF HELICAL WAVES IN A QUASIRELATIVISTIC PLASMA BY AN ALTERNATING ELECTRIC FIELD

PAVERMAN, V. S.

[Text] The propagation of waves in a quasirelativistic (subject to the Kane dispersion law) degenerate electron plasma of a semiconductor is analyzed here for the case of such a plasma being in a constant magnetic field and an alternating electric field. The polarization of the pumping wave is taken as circular and its amplitude is assumed as not very large. The dispersion equation is derived in the hydrodynamic approximation. The spectrum of propagated waves is found to change appreciably upon the application of an alternating electric field. In particular, there appear branches of transverse low-frequency oscillations which become unstable under certain conditions. This suggests the feasibility of generating waves whose frequency varies with the amplitude of the pumping wave. The results of this analysis are also applicable to a relativistic electron plasma of a gas.

ANALYSIS OF NONHOMOGENEOUS SEMICONDUCTOR STRUCTURES BY THE METHODS OF NON-EQUILIBRIUM THERMODYNAMICS

BALIM, G. M., editorial board INZH.-FIZ. ZHUR., Academy of Sciences of the Belorussian SSR, Minsk

[Text] A nonlinear multiterminal network is considered. On the assumption that an increase in entropy at any point of a body accompanies a departure from equilibrium (with no absorption of heat), an expression is derived for the rate of entropy buildup on the basis of which phenomenological transport equations can be written for vector fluxes in accordance with the number of electrodes and p-n junctions. On the basis of Melegi's postulates (INTERANT'L JOUR. ELECTRONICS Vol 24 No 1, 1968 p 41) with a few stipulations, to every thermodynamic force is assigned a corresponding physical force acting on an electron and a hole. The mobility of electrons and holes is expressed as a matrix quantity which corresponds to the matrix of physical forces. On this basis and with the aid of Onsager's relation are now calculated the kinetic coefficients in the transport equations. The results are useful for calculating the thermal emf and the photo emf across electrodes, also for analyzing the electrical characteristics of devices. In an illustrative example, the generalized Ebers-Moll equations are set up with consideration of volumetric impedances and leakage admittances, also in the case of structures having more electrodes than regions (of the twin-base diode type). References 9.

ELECTROPHYSICAL PROPERTIES OF As_2S_3 FILMS

KUGEL', KH. I., ABOLTIN', E. E., and GRANT, Z. A., Riga Red Banner Institute of Civil Aviation Engineers imeni Lenin Komsomol

[Abstract] Employing a capacitor method the authors investigated the electrophysical properties of As_2S_3 films on substrates of silicate glass and of the substrates themselves. They demonstrate that the electrophysical properties of silicate glasses can be stabilized and made uniform by annealing. They found that the electrophysical properties of the films vary with a thickness up to 7-8 micrometers and then remain constant. This stabilization of

the electrophysical properties is achieved as a result of annealing in the temperature range of 470-520 K for 1 hour and subsequent cooling at room temperature. Figures 2; tables 2; references 8 (Russian).

HEAT TRANSFER DURING THE TURBULENT FLOW OF A GRAVITATIONAL LIQUID-METAL FILM OVER A VERTICAL WALL

GIMBUTIS, G. I., Kaunas Polytechnic Institute imeni Antanas Snechkus

[Russian abstract provided by the source]

[Text] The author cites the results of a theoretical investigation of heat transfer during the turbulent flow of a gravitational liquid-metal film over a vertical flat wall. The theoretical investigations were carried out on the basis of the semiempirical theory of turbulence using data obtained in an experimental investigation of the velocity field in a turbulent film of water flowing over a vertical surface. The obtained results are written as the empirical equation

$$Nu_d = 9 + 0.04\ Pe^{0.8}.$$

On the basis of the experimental data concerning contact heat resistance in the flow of contaminated liquid metals in pipes the author determines the degree of decrease in heat exchange in the case of contaminating the film with impurities. Figures 3; references 16: 14 Russian, 2 Western.

CHANGE IN THE CONDUCTIVITY TYPE IN EPITAXIAL CdS AND CdSe FILMS

SERGEYEVA, L. A., KONRAD, L. A., and BOGOMOLOV, N. S., editorial board IZV. VUZOV FIZIKA, Tomsk

[Text] The structure, the composition, and the electrophysical properties (resistivity ρ and mobility μ of charge carriers) of epitaxial CdS and CdSe films were studied, after specimens had been annealed in air or in a vacuum of 10^{-4} mm Hg. It has been found that annealing these films in the presence of oxygen changes electron conductivity to hole conductivity. The maximum hole mobility is 40 cm^2/V·sec in air-annealed CdS films and 48 cm^2/V·sec in air-annealed CdSe films. A model is proposed for explaining the experimentally obtained time and temperature characteristics of ρ and μ where the major factors in affecting the properties of these films during heat treatment in the presence of oxygen are: a) at low annealing temperatures diffusion of Cd to the specimen surface and, in some cases, chemosorption of O_2 with the oxygen relacing chalcogen vacancies; b) at higher annealing temperatures diffusion of Cd to the specimen surface with its subsequent oxidation, film recrystallization processes, and interaction between the $A^{II}B^{VI}$ lattice and O_2 resulting in an evolution of gaseous SO_2 or SeO_2. References 18.

SHAPE OF THE EXCITON ELECTROABSORPTANCE LINE IN 6H SiC

SANKIN, V. I., and SOKOLOV, V. I.

[Text] The electroabsorptance spectrum at 4.2 K shows lines of the exciton series n = 1,2,3 with a simultaneous emission of an LA phonon. From the energy levels of these lines has been determined the exciton bond energy

E = 78 eV, in this case $\mathcal{E} \ll E/e\alpha$ up to 10^5 V/cm ($\mathcal{E}$ denoting the intensity of the external electric field and α denoting the radius of an exciton). Here the effect of an electric field is a Stark shift of the energy level and a change in the wave function. The shape of the LA electroabsorptance line with $E_M = 3.10$ eV, is analyzed according to the theory of electroabsorptance for the case $\mathcal{E} \ll E/e\alpha$ (it is pointed out that the wave functions and Lorentz line broadening have been determined here from experimental data by the λ-modulation method). It is also noted that the theory of exciton electroabsorptance satisfactorily describes the shape of the exciton electroabsorptance line in SiC for the case of low field strengths.

ELECTROREFLECTANCE SPECTRA AND ELLIPSOMETRY OF $ZnSe_xTe_{1-x}$ SEMICONDUCTOR ALLOYS

TYAGAY, V. A., YEVSTRIGNEYEVA, A. M., KRASIKO, A. N., and VITRIKHOVSKIY, N. I.

[Text] The optical properties of p-$ZnSe_xTe_{1-x}$ cubic single crystals (p = 10^{15}-10^{16} cm^{-3}) at T = 300°K were measured by the electroreflectance method and by ellipsometry (model E-1 ellipsometer with a monochromator). The thickness and the refractive index of the surface oxide film as well as the dispersion of the refractive index have thus been determined. Depending on the $n(\lambda)$ characteristic, there appears a peak at the wavelength λ corresponding to the edge of intrinsic absorption in any given $ZnSe_xTe_{1-x}$ alloy. The electroreflectance spectrum in a weak field at the edge of intrinsic absorption contains four extrema, and the theory of the electro-optic effect of ionized excitons (REF. ZHUR. FIZ. 1977 Abstracts 3E907 and 9E873) explains such a spectrum in a satisfactory manner. This model yields for the parameter $\hbar\Gamma$ of line broadening the value 25-30 eV and for the energy at the critical point 2.14-2.18 meV, with x varying from 0.15 to 0.35. The close agreement between the third derivative of permittivity, as determined ellipsometrically, and the form of the electroreflectance spectrum confirms the validity of the theory. Calculations for the extreme case of high field intensity, with line broadening taken into account, do correctly describe the electroreflectance spectrum measured in a strong field, and this has made it possible to determine the reduced effective mass for $ZnSe_{0.25}Te_{0.75}$ ($\mu = 0.17$ m_o).

EFFECT OF TEMPERATURE AND DOPING ON THE EXCITON SPECTRA OF ZnTe AND CdTe

LISITSA, M. P., TEREKHOVA, S. F., and TSEBULYA, G. G.

[Text] The exciton spectra of p-ZnTe and Br-doped n-CdTe single crystals
with the concentration of free carriers ranging from $1 \cdot 10^{15}$ to $5.9 \cdot 10^{17}$ cm^{-3}
were analyzed over a wide temperature range ($4.2 \lesssim T \lesssim 100$ K) by the photo-
reflectance method. The exciton level E_{exc} and the Lorentz line broadening
parameter Γ determined by the three-point method, according to the results
in REF. ZHUR. FIZ. 1973 Abstract No 12E1336. It has been found that free
carriers do not affect the E_{exc} level in CdTe within this range of their
concentration. The broadening of the spectral lines of photoreflectance with
higher concentration of free carriers ($\Gamma \sim N^{1/2}$) is most probably caused by
the presence in a specimen of a random field of charged impurities. The
authors suggest exciton-phonon interaction and a change in the field intensi-
ty at the surface as possible causes of the broadening of photoreflectance
lines and of the change in their symmetry at higher temperatures.

HARMONICS OF ELECTROABSORPTANCE IN GaAs

AKOPYAN, R. M., BEROZASHVILI, YU. M., DZHANELIDZE, M. B., DUNDUA, A. V., and
TSITSISHVILI, YE. G.

[Text] A harmonic analysis of longitudinal electroabsorptance in GaAs cry-
stals was performed experimentally. In this experiment were measured the
harmonics in the variation of absorptance $\Delta \alpha$ due to an alternating electric
field. It appears that both longitudinal and transverse electroabsorptance
contain odd harmonics $\Delta \alpha_{2n-1}$. Their amplitude depends strongly on the ori-
entation of the crystallographic axes relative to the external electric field
as well as on the polarization of the incident light. Relations are derived

for the first harmonic of such an absorption, as a function of the angle between the electric vector of the light wave and the [001] axis of the crystal, for three different orientations of the external electric field. An analytical expression is also derived for the second-harmonic to fundamental intensity ratio.

POLARIZATION OF THE RADIATION FROM EXCITONS AND ELECTRON-HOLE DROPS IN GERMANIUM AND SILICON RESULTING FROM UNIAXIAL DEFORMATION

ALKEYEV, N. V., KAMINSKIY, A. S., POKROVSKIY, YA. E., and SVISTUNOVA, K. I.

[Text] A study was made concerning the effect of uniaxial compression along axis [111] in germanium and along [100] in silicon on the degree of polarization of the radiation from free excitons and from electron-hole drops. In germanium both radiations are first polarized at the long-wave edges of the LA band and the TO band and with rising pressure, they become polarized over these entire bands. Moreover, the polarization is normal to the [111] axis in the TO band and parallel to the [111] axis in the LA band. In the TO band it requires a pressure $P = 120-150$ kgf/cm^2 to completely polarize the radiation from free excitons and a pressure $P = 300-350$ kgf/cm^2 to completely polarize the radiation from electron-hole drops. In the LA band the radiation from free excitons reverses its polarization at $P \simeq 275$ kgf/cm^2, which corresponds to splitting of the exciton level $|\Delta_c| = 0.8$ meV. The radiation from electron-hole drops in this band does not reverse its polarization but becomes completely polarized at $P - 10^3$ kgf/cm^2, which corresponds to splitting of the valence band $\Delta_h \simeq F_h \simeq 3.0$ meV. In silicon the radiation from free excitons becomes completely polarized under minimal pressures, while polarization of the radiation from electron-hole droplets begins at the long-wave edge of a band and becomes complete under $P \simeq 1600$ kgf/cm^2. This corresponds to a split of the conduction band $\Delta_c \simeq 14$ meV. The authors conclude that the radiation from collective states, in germanium as well as in silicon, is due to recombination of charge carriers in a highly degenerate nonequilibrium plasma.

UDC 537.226;537.311.322

ELECTRICAL CONDUCTIVITY OF PHOTOSENSITIVE MICROCRYSTALLINE CdS:Cu,Ga POWDERS
IN ALTERNATING ELECTRIC FIELDS

Tomsk ELEKTROPROVODNOST' FOTOCHUVSTVITEL'NYKH MIKROKRISTALLICHESKIKH POROX-
HKOV GaS:Cu, Ga V PEREMENNYKH ELEKTRICHESKIKH POLYAKH in Russian 1976 7 pp
(manuscript deposited in the All-Union Institute of Scientific and Techni-
cal Information 21 Oct 76 No 3750-76 Dep)

AFON'KO, A. YA., TONKOSHUR, A. S., CHERNENKO, I. M., and YAKUNIN, A. YA.,
editorial board IZV. VUZOV, FIZIKA, Tomsk

[Text] A study was made concerning the photodielectric characteristics of
photosensitive microcrystalline CdS:Cu,Ga powder specimens. Based on an
analysis of the frequency characteristics of the permittivity and loss tan-
gent, the authors have then calculated the current-illuminance characteris-
tics of powdered CdS:Cu,Ga. It appears that the electrical conductivity
of this system increases with higher frequency of the applied alternating
electric field. References 8 (Russian).

UDC 537.226;537.311.322

INTERACTION BETWEEN ELECTRON-HOLE DROPS AND ULTRASONIC WAVES IN PURE
GERMANIUM

Tbilisi MODULYATSIONNAYA SPEKTROSKOPIYA POLUPROVODNIKOV I DIELEKTRIKOV
[Modulation Spectroscopy of Semiconductors and Dielectrics.. Collection
of Articles] in Russian 1975 pp 15-20

ALEKSEYEV, A. S., GALKINA, T. I., and MASLENNIKOV, V. N.

[Text] The attenuation of ultrasonic waves (frequency 160 MHz) was studied
in pure germanium at liquid-helium temperatures, with optical excitation
and with a specimen containing electron-hole drops. The recombination radi-
ation from these drops has been found to become more intensive during genera-
tion of sound in a specimen with external modulation, which is attributed to
a "buildup" and a resulting enlargement of these drops, i.e., of the liquid-
phase volume by ultrasonic waves. Conversely, a "quenching" of radiation
from these drops has been found to occur during continuous generation of
sound, which is attributed to a spatial separation of these drops from ex-
citons in a standing sound wave and, therefore, to a loss of thermodynamic
equilibrium between them.

USSR   UDC   548-162:539.16.04;548-162:539.12.04

EFFECT OF VACANCIES ON THE RADIATIVE SPUTTERING OF METAL SURFACES

Tashkent VLIYANIYE VAKANSIY NA RADIATSIONNOYE RASPYLENIYE POVERKHNOSTEY
METALLOV in Russian 1976 19 pp (manuscript deposited in the All-Union Insti-
tute of Scientific and Technical Information, 25 Oct 76 No 3777-76 Dep)

GURVICH, L. G., and BESPALOVA, N. S., editorial board IZV. AKAD. NAUK UzSSR,
Ser. Fiz.-Matem. Nauk

[Text] Computer simulation methods are used to determine the effect of
vacancies in the surface layers of metals on the escape of sputtered atoms.
The presence of vacancies in these layers is found to lower the coefficient
of radiative sputtering. References 5.

USSR   UDC   548-162:539.16.04;548-162:539.12.04

KINETICS OF SPACE-CHARGE ACCUMULATION IN SOLID DIELECTRICS DURING BOMBARD-
MENT WITH ACCELERATED ELECTRONS

Tomsk KINETIKA NAKOPLENIYA OB"YMNOGO ZARYADA V TVERDYKH DIELEKTRIKAKH PRI
OBLUCHENII IKH USKORENNYMI ELEKTRONAMI in Russian Tomsk Polytechnical Insti-
tute 1976 11 pp (manuscript deposited in the All-Union Institute of Scien-
tific and Technical Information, 1 Oct 76, No 3492-76 Dep)

VOROB'YEV, A. A., ANNENKOV, YU. M., BOYEV, S. G., and SIGAYEV, G. I..

[From REFERATIVNYY ZHURNAL FIZIKA No 1 (II) 1977 Abstract No 1Ye694 DEP by
the authors]

[Text] A model is proposed for describing the accumulation of space charge
in solid dielectrics bombarded with accelerated electrons. Unlike the Gross
model, this one accounts for charge leakage through the unexposed bulk of a
specimen and also for the charge accumulated at the end of the path of the
injected electrons due to nonuniform electrical conductivity of the material.
The model is satisfactory for interpreting the results of electrode current
measurements in bombarded polytetrafluoroethylene specimens. References 7.

USSR   UDC   548-162:539.16.04;548-162:539.12.04

PRODUCING THE RADIOELECTRET EFFECT IN SOLID DIELECTRICS BY BOMBARDMENT
WITH ACCELERATED ELECTRONS

ZAVADOVSKAYA, YE. K., ANNENKOV, YU. M., BOYEV, S. G., and SIGAYEV, G. I.

[Text] A theoretical and experimental study was made concerning the kinetics
of formation of electric moments in solid dielectrics bombarded with fast
electrons in the atmosphere. The energy of bombarding electrons in the ex-
periment ranged from 0.6 to 2.0 MeV, at an incident flux density ranging
$1 \cdot 10^{-9}$ to $5 \cdot 10^{-7}$ A/cm^2. The specimens were actually grounded during bombard-
ment, owing to the high electrical conductivity of the ionized ambient gas
and the electric moments were equal to zero. The formation of electric mo-
ments occurred after cessation of the bombardment, because the density of
the accumulated space charge had become redistributed. An examination was
made of the redistribution of space-charge density due the electrical con-
ductivity of the dielectric, due to intrinsic charge carriers, and due to
the release of charges stored in traps. Analytical relations derived for
the kinetics of the electric moments give a qualitative description of the
experimental results. References 5.

HUNGARY

THE PHOTOELECTRIC EFFECT AT VERY HIGH LIGHT INTENSITIES: IDENTIFICATION
OF THE MANY-PHOTON PHOTOELECTRIC EFFECT WITH LASER LIGHT

FARKAS, GYOZO, Main Optical Department, KFKI [Central Research Institute
of Physics]

[Abstract] Experiments were done under optimum and close to ideal condi-
tions in which noble metals with ideal optical (reflection) properties
(Au, Ag, Ni) were exposed to nanosecond and picosecond laser pulses incident
at an angle of approximately 5°. As a result of the short pulse duration
and the almost 100% reflection, absorption was largely suppressed and
thermal emission eliminated. By means of the polarization dependance of
the ruby laser(nanosecond pulse, Ag cathode) it was shown that pure photo-
emission occurs at $h\nu < A$: n = 3 also; the photoelectric effect is of the many-
photon surface type. The j(I) relationship was also examined in this set-
up. The theoretically expected values were found. Some effects were
demonstrated for the first time; others subsequently duplicated them. All
these results were published in international monographs. The work was
carried out in cooperation with the P. N. Lebedev Institute of Physics in
Moscow, Academicians Prokhorov and Keldysh, and the research center in
Saclay. Figures 3.

'TRAPPED' RADIATION IN A WAVEGUIDE

ARUTYUNYAN, KH. S., LAZIYEV, E. M., and OKSUZYAN, G. G., Yerevan Physics
Institute

[Russian abstract provided by the source]

[Text] An experimental study is done on the way that "trapped" emission energy
depends on waveguide dispersion with axial and perpendicular travel of electron
bunches through the waveguide. It is shown that the energy of the "trapped"
emission in the frequency region lying between the critical frequencies of an
empty waveguide and one filled with a dielectric (plate) may exceed the energy
in a cylindrical dielectric-filled resonator. This can be attributed to the
fact that the Q of the resonator formed by a plate in a transcritical wave-
guide increases due to sagging of the field into the empty waveguide region.
With an increase in λ_0/λ_{cr} the sag of the field decreases, the resonant length
of the plate $\gamma_d \to \pi$, and the emission in the resonator becomes greater than the
"trapped" radiation as the emission on the metal ends of the resonator begins
to make its contribution. References 4 (Russian).

TRANSITION RADIATION ENERGY LOSSES AS A FUNCTION OF WAVEGUIDE DISPERSION

OKSUZYAN, G. G., and POGOSYAN, E. S., Yerevan Physics Institute

[Russian abstract provided by the source]

[Text] An experimental study is done on the way that the energy spent on
transition radiation depends on dispersion and on the nature of the dielectric
filler of a rectangular waveguide with excitation of the H_{10} wave. It is
established that as the permittivity of a homogeneously filled waveguide in-
creases, there is a reduction in energy losses due to disruption of the abrupt-
ness of the metal-vacuum boundary. The dependence of energy losses is measured
in the case of a single interface between the media that fill the waveguide for
distances between the trajectories of motion of electron bunches and the inter-
face that are comparable with the radiation wavelength. Energy losses in the
case of a dielectric plate with $\varepsilon = 1$ exceed the losses in a homogeneously
filled waveguide when the length of the plate is half the wavelength in the
waveguide. The results found in the paper can be used for instance for diag-
nosing bunches of relativistic charged particles. References 5 (Russian).

EXPLOSIVE EMISSION IN NONOSECOND GAS DISCHARGES

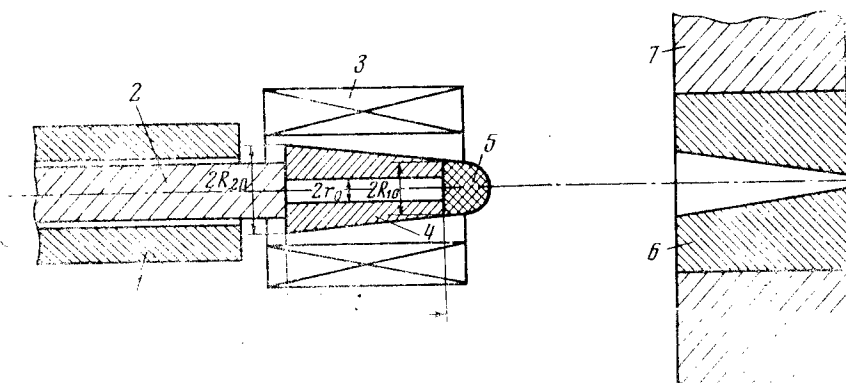BABICH, L. P., BEREZIN, I. A., LOYKO, T. V., TARASOV, M. D., TARASOVA, L. V.,
and CHIKINA, R. S.

[Abstract] According to data in the literature, the principal role in the
supply of electrons that initiate self-maintained nanosecond electric dis-
charges in gases is played by the field emission that may arise with external
field intensity $E \sim 10^5 - 10^6$ $V \cdot cm^{-1}$ because of microprojections on the cathode
surface that appreciably intensify the external field. It has been hypothe-
sized that microprojections may explode, bringing about a transition from
field emission to explosive emission in gas discharges in fields exceeding
10^5 $V \cdot cm^{-1}$. The authors report on experiments done to check this hypothesis.
Characteristics of nanosecond gas discharges in air were studied at pressures
up to 1 atmosphere. The discharges were set off in chambers with massive
cathodes having a hemispherical working surface with radius of 3 and 6 mm.
The anode was aluminum foil 15 μm thick. The interelectrode distance was 15
mm. A voltage pulse was applied across the discharge gap with steepness of
the leading edge surpassing 10^{14} $V \cdot s^{-1}$. This provided a voltage pulse at
atmospheric pressure with amplitude of 70-100 kV and duration of $\sim$5 ns. The
results show that the emission of the cathode region of the plasma consists
of an intense continuum and a line emission spectrum showing more than 100
spark lines of Fe II, 17 spark lines of Cr II and 12 bands that belong to the
second positive system of N_2. These bands alone were observed in the diffuse
luminescence spectrum. The presence of Fe II and Cr II lines and absence of
intense Fe I and Cr I arc lines shows the high temperature of the cathode
plasma, and can be considered confirmation of explosive emission of electrons
from the cathode. The authors also investigated electrode erosion in gas
discharges. It was found that the nature of erosion depends on pressure and
electrode material. The intensification of the field, discharge emission
spectrum and cathode erosion show the possibility of explosive emission in
gas discharges. However, it is noted that the role of the explosive plasma
decreases as compared with vacuum discharges since the dense gas discharge
plasma in the cathode region acts as a stimulator of electron emission from
the cathode. References 10: 7 Russian, 3 Western.

AMPLIFICATION OF MAGNETIC FIELDS WITH CONFOCAL MOTION OF A PASTICALLY DEFORMABLE HOLLOW CONE

KIRKO, I. M., academician, Academy of Sciences Latvian SSR, KIRKO, G. YE.,
Department of Polymer Physics, Ural Science Center, Academy of Sciences USSR,
Perm'

[Abstract] A principle of generation of strong magnetic fields is considered
that differs from conventional techniques in that the magnetic flux is coupled
out of the excitation solenoid and is compressed outside of it (see figure).

1--gun barrel; 2--guide; 3--solenoid; 4--projectile; 5--nose cone; 6--armor-
clad cone; 7--wall.

A projectile in the form of a thick-walled cone with inner cylindrical cavity
of radius r_0 is placed inside the solenoid that creates the magnetic field
B_0. When it flies from the solenoid at given velocity v_0, the projectile
carries part of the magnetic field with it. At a distance L_0 from the solenoid
is a massive concrete wall through which is a tapered hole with minimum radius
much less than r_0. The distance between the solenoid and the wall is given
by the condition $\delta \ll R_{10} - r_0$, where R_{10} is the minimum outside radius of the
projectile, and $\delta = 2\sqrt{t(\mu_0 \sigma_0)^{-1}}$ is the depth of penetration of the field in
time $t = L_0/v_0$, μ_0 is vacuum permeability, and σ_0 is the conductivity of the
missile material. If $v_0 = 1000$ m/s, $L_0 = 5$ m, and the projectile is made of
copper and cooled to liquid nitrogen temperatures, it can be assumed for prac-
tical purposes that all the magnetic flux is carried by the projectile into
the tapered hole in the wall. As the projectile penetrates into the tapered
hole, the cylindrical cavity inside is compressed and the magnetic field
strength is thereby increased. Formulas are derived for the maximum attain-
able field strength. The results show that it should be possible to gener-
ate magnetic fields with induction of 50-70 T by this technique.

A STABILIZATION DIVIDER FOR THE OUTPUT VOLTAGE OF A CASCADE GENERATOR

PTUKHINA, Z. YE., and VENEVTSEV, I. T.

[Text] The paper describes an experimental 200 kV voltage divider designed
for the output voltage stabilization system of a cascade generator. Reasons
are given for choosing a capacitive-resistive type of divider and the ele-
ments -- 1 MΩ MGP-0.5 resistors and KSO-13 capacitors--from which it is con-
structed. Test oscillograms are given for the divider, and also its tech-
nical specifications.

THEORY OF ELECTRICAL CONDUCTION IN LIQUID METALS CONSIDERING THREE-PARTICLE INTERIONIC CORRELATIONS

KOVALENKO, N. P., and SHVETS, V. T.

[Text] A theory of electrical conduction in liquid metals is proposed where
the electrical resistance has been expressed in the form of a pseudopotential
series and where the pseudopotential third-order correction to the Born ap-
proximation has been calculated numerically with consideration of various
pseudopotentials and various methods of splitting the three-particle struc-
tural factor into two-particle factors. References 10.

UDC 546.3-14;532:621.315.592

THERMAL EMF OF INDIUM-BISMUTH ALLOYS BETWEEN MELTING AND CRYSTALLIZATION

IVLEV, V. I., and YUDIN, V. A.

[Text] The results are shown of an experimental study concerning the ab-
solute thermal emf (α) of indium-bismuth alloys with a one-phase solid-
solution structure in the solid state. The integration method was used for
measurements. Melting of these alloys is accompanied by a jumpwise decrease
in the thermal emf, with the magnitude of this jump decreasing with a high-
er bismuth content in the alloy. The transition from solid state to liquid
state on the $\alpha(T)$ curves is rather abrupt for all these alloys, except In -
20% wt Bi, without pre- or post-transition anomalies. On the $\alpha(T)$ curve
for the In - 20% wt Bi alloy there appears a transition zone within the
same temperature range where the alloy exists in the two-phase state (be-
tween the solidus and the liquidus). References 3.

UDC 537.621

MAGNETIC, ELASTIC, AND THERMAL PROPERTIES OF INVAR ALLOYS Fe-Ni + 8.3 atom%
Mn

KALININ, V. M., KHOMENKO, O. A., and DUNAYEV, F. N.

[Text] A study was made concerning the effect of manganese in Invar alloys
on their Curie point, on the components of anomaly of the modulus of elas-
ticity, and on their thermal expansion. It has been established that man-
ganese increases the magnitude of the thermal expansion coefficient and of
the thermoelastic coefficient in the paramagnetic state, while it suppresses
the invar effect and the Δ E effect. It is also shown how a nonuniform distri-
buton of manganese in austenite blurs the ferromagnetic transformation of
Invar alloys.

USSR   UDC 537.621

MEAN MAGNETIC MOMENT AND ELECTRON CONCENTRATION IN DOPED IRON-NICKEL ALLOYS
OF THE INVAR TYPE

KALININ, V. M.

[Text] The results are shown of an experimental study concerning the mean
magnetic moment $\bar{\mu}$ in Fe-Ni alloys doped with 3d-transition metals. A corre-
lation has been established between $\bar{\mu}$ and the concentration of d+s electrons
which, in turn, establishes an electronic criterion for iron-base Invar and
Elinvar alloys. The exchange interaction is shown to depend on the distance
between Fe atoms, at the critical point where the $\bar{\mu}(n_{d+s})$ curve departs from
miscibility law.

USSR

NONLINEAR CYCLOTRON RESONANCE IN METALS

KOPASOV, A. P., Physico-Technical Institute, Gor'kiy State University

[Russian abstract provided by the source]

[Text] An examination is made of nonlinear reflection on the frequency of
the second harmonic in the case of the anomalous skin effect from metal
placed in a strong magnetic field parallel to its surface. It is shown that
in this case the nonlinearity is much greater than that without a magnetic
field, and that the amplitude of the reflected second harmonic undergoes
oscillations of cyclotron resonance, and increases in addition when the
condition $\omega = 1/2 l \Omega_m$ is satisfied, where ω is the frequency of the electro-
magnetic wave, Ω_m is the extremum cyclotron frequency, and l is an integer.
References 12: 10 Russian, 2 Western.

EFFECT OF A STATIC MAGNETIC FIELD ON THE GROUND STATE OF A THIN MAGNETIC FILM

ZUYEV, A. V., YERUKHIMOV, M. SH., and SEMENTSOV, D. I.

[Text] The methods of micromagnetism theory are used for analyzing the magnetization distribution in a thin magnetic film with magnetic volume anisotropy (easy plane) and magnetic surface anisotropy (easy axis) in a static magnetic field parallel to its plane. An analysis of the solution to this problem without an external field reveals that there is always a non-zero angle between the magnetization vector and the symmetry axis at the center of a plate. The maximum angle $\frac{\pi}{2}$ between them is possible only in an infinitely thick specimen or in an infinitely strong field. Curves have been plotted of the distribution of this declination angle as a function of the Z-coordinate (with respect to film thickness). As the field intensity increases or the film thickness decreases, the region of highly nonuniform magnetization becomes larger.

ENERGY OF TWIN DOMAIN WALLS IN NICKEL FILMS

PANAETOV, V. P., and POPOV, V. I.

[Text] The energy of two domain walls very close to one another is calculated in thermodynamic terms. Pairs of Neel walls as well as pairs of Bloch walls in nickel films of varying thickness are considered. Such pairs may be formed by walls with the same or with opposite spin rotations. The results of these calculations indicate that, in the absence of an external magnetic field, no twin Neel walls occur in nickel films. The energy (per unit length) of twin Bloch walls with opposite spin rotations is higher and that of twin Bloch walls with the same spin rotations is lower than the sum of the energies of two isolated such walls in each case. In nickel films 100-700 Å thick the energy of interaction between neighboring walls must be taken into account when the distance between them is smaller than 10^4 Å. In nickel films

100 $\overset{\circ}{A}$ thick with K $\sim$ 10^6 erg/cm^3, stable twin Bloch walls should be in equilibrium when separated by approximately 4000 $\overset{\circ}{A}$. This theoretical conclusion has been confirmed by experiment. The authors suggest that twin walls in thin nickel films consist of Bloch walls or of mixed walls with a large Bloch component.

DOMAIN STRUCTURE OF SINGLE-CRYSTAL NICKEL FILMS 1-50 µm THICK

LEVENKO, V. V., GOLOVNEV, YU. F., and CHERKASHIN, V. S.

[Text] The method of magnetic suspensions was used for studying the domain structure of single-crystal nickel films 1-50 µm thick which had been produced by the chemical transport process with subsequent separation from the crystal substrate and annealing at 750-800°C. After removal of the field, the stable domain structure appears in the form of narrow stripes with a space period of a few µm elongated in the [110] directions of easy magnetization. Upon application of a weak transverse field of 400-2400 A/m the period of the microstripe domain doubles. In a transverse field of 6400-8000 A/m the stripes abruptly rotate in the direction of the field, if the film has been removed from the substrate. In films bonded to the substrate such a rotation occurs only when the field has reached $(4.0-6.4) \cdot 10^4$ A/m, evidently because of high magnetostrictive stresses in nickel. When the magnetizing field (about $4 \cdot 10^4$ A/m) is applied perpendicularly to the plane of the film, then a weakening of the planar component of magnetization in the subdomains results in the formation of a labyrinth domain structure instead of elongated stripes.

EFFECT OF ELASTIC STRESSES ON THE VELOCITY OF DYNAMIC DOMAINS MOVING IN
PERMALLOY FILMS

BURAVIKHIN, V. A., ANUFRIYEV, V. S., KARASOV, P. I., KAZAKOV, V. G., and
TAUBER, V. V.

[Text] None

EFFECT OF AN EXTERNAL MAGNETIC FIELD ON THE STRUCTURE OF DOMAIN WALLS WITH
CROSS TIES

KARABANOVA, V. P., and ANTIP'EV, G. V.

[Text] The magnetic structure of Permalloy films (20% Fe – 80% Ni) 200-800
Å thick, which had been produced by thermovacuum evaporation of freshly
cleaned NaCl, was examined under a model UEMV-100 electron microscope in the
shadow mode of operation. It has been thus discovered that the structure of
periodically spaced walls with cross ties depends on the film thickness, on
the conditions of demagnetization, and on the constant of uniaxial magnetic
anisotropy. The distribution of magnetization between the cross ties in films
about 300 Å thick has been found to follow a parabolic law with the most like-
ly period 9 μm. The magnetic flux between the cross ties in films 600 Å or
thicker can be simulated by an array of equidistant lines which connect para-
llel straight lines with arcs of concentric circles, the center of the latter
being also the center of a Bloch line. The distance between cross ties is
about 7 μm. Nickel films 600 Å thick with a orthogonal anisotropy of the
order of 10^6 ergs/cm^3 feature a very high density of constrictions with a
space period of only 0.46 μm. Under the influence of a field $H_\perp$ oriented in
the difficult direction the circular Bloch lines become shifted toward the
constrictions, which results in the annihilation of Bloch line pairs and the
formation of uniformly polarized Neel walls. As the thickness of Permalloy
films is increased from 200 to 800 Å, the transition to a homogeneous Neel

structure occurs at a field intensity gradually decreasing from (0.5-0.9) H_C to 0.4 H_C. It is also noted that the width of major Néel wall segments with constriction changes with a change in the intensity of the transverse field. A hysteresis has been found in the dependence of the angle θ between the magnetization vector near a wall and the easy axis ($H_\perp$) on the field intensity. This hysteresis in the rotation of the magnetization vector has to do with the hysteresis of changes in the wall structure in a transverse field.

USSR   UDC   539.1.08

A NANOSECOND COMMUTATOR

RUDENKO, N. S., REMNEV, G. YE., and SHATANOV, A. A., Scientific Research Institute of Nuclear Physics, Electronics and Automation Affiliated with Tomsk Polytechnical Institute

[Text] A design is proposed for an improved nanosecond commutator that contains several main dischargers and one trigger discharger that are connected in parallel with a shaping line. The two-electrode trigger discharger is connected across half the total voltage, and its high-voltage electrode is connected through resistors to auxiliary electrodes built into the middle of the electrodes of the main dischargers. To reduce the commutation time, the middle electrodes of the main dischargers are made in the form of plates with sharp edges, and the commutator is completely filled with a liquid dielectric.

USSR   UDC 539.1.08

A DEVICE FOR AMPLIFYING ELECTRIC SIGNALS OF SEMICONDUCTOR DETECTORS

IOANNESYANTS, L. M.

[Text] An improved device is proposed for amplifying the electric signals
of semiconductor detectors. The device contains an amplifier, a discrimina-
tor, two switching stages, a differential device and two Kipp oscillators
(main and auxiliary). A block diagram is given for the proposed device and
its working principle is described. The device is distinguished from con-
ventional units by a much lower level of distortions of amplified signals.

USSR   UDC 537.533

GENERATION AND STUDY OF A HIGH-CURRENT MICROSECOND ELECTRON BEAM

ROYFE, I. M., STEKOL'NIKOV, B. A., and ENGEL'KO, V. I., Scientific Research
Institute for Electrophysical Apparatus imeni D. V. Yefremov, Leningrad

[Russian abstract provided by the source]

[Text] The paper describes a high-current diode with cold cathode in which
a current pulse with duration of more than 1 µs is generated by creating a
magnetic mirror in the anode region to decelerate the cathode jet plasma.
The diode characteristics are given. It is shown that the plasma velocity
close to the anode drops by an order of magnitude as compared with the case
where there is no magnetic field in the diode. The diode impedance does not
vary over a time interval of 2-4 µs. The beam is brought out into a central
aperture in the anode, and drifts for about 70 cm. Visual and microscope
inspection of beam imprints on metal foils showed that there are conditions
under which the beam is unstable in the drift space. References 11: 6
Russian, 5 Western.

WAVE FUNCTION OF AN ELECTRON IN A MAGNETIC FIELD IN THE ROTATOR APPROXIMATION

KHOLOMAY, V. V., Moscow Power Engineering Institute

[Abstract] Electron wave functions are found in the rotator approximation with consideration of only the orbital moment of the electron. It is shown that the resultant approximate Laguerre functions satisfy the initial system of Dirac equations with accuracy to terms of order $O(l^{-3/2})$ (where l is the quantum number characterizing the moment along the z-axis), which is sufficient for consideration of quantum corrections in emission that are quadratic with respect to $\hbar$. The effect of self-polarization of electron spin is demonstrated. References 5 (Russian).

HUNGARY

MOVEMENT OF DOMAIN WALLS IN UNIAXIAL MAGNETIC SUBSTANCES

ZIMMER, GYORGY, Department of Magnetism, KFKI [Central Research Institute of Physics]

[Abstract] The domain structure of thin sheets (bubbles and stripes), the structure of the domain walls, the movement of the domain walls, and some experimental results pertaining to the foregoing are discussed. It was demonstrated that the structure of uniaxial magnetically anisotropic thin sheets is complex and has a periodic structure along the wall if the substance is of the domain type. If no such periodic structure exists, the general structure is relatively simple. Neither structure is capable of moving under the direct influence of the magnetic space featuring one of the two possible magnetization directions of the domain. The mechanism leading to the movement of the wall of complex structure involves fast lateral movement in the wall plane and slow movement perpendicular to this direction. Wall-structure changes may develop as a result of such movement. All this was confirmed by slow-motion cinematographic studies. The movement mechanisms of the simple structure are not yet fully elucidated. There are many unexplained contradictions between theoretical concepts and results obtained by experimental means. Figures 6.

Fluid Dynamics

ACCELERATION OF A LAMINAR BOUNDARY LAYER ON A SURFACE THAT IS PARTLY IN
MOTION

RUDERMAN, YA. L., Moscow State University, Department of Gasdynamics and
Wave Dynamics

[Abstract] An important tool for handling boundary layer separation is the
inclusion of movable elements in the flow surface that move in the direction
of the main flow. As a rule, difficulties arise in theoretical calculation
of boundary layers close to the line where there is an abrupt change in the
boundary conditions. The author proposes a technique for solving the boundary
layer equations in this region on a surface where the forward segment is sta-
tionary while the trailing segment moves with a constant velocity in a direc-
tion coinciding with that of the external flow. It is assumed that the fluid
is incompressible and that flow is plane-parallel and laminar. It is assumed
that upstream from the line of discontinuity in the boundary conditions one
can disregard the perturbing influence that the motion of the trailing seg-
ment has on the velocity profile and pressure distribution in the boundary
layer. The solution is sought in the form of spliced coordinate series, one
describing flow in the internal region of the boundary layer, and the other
describing flow in the external region. Splicing conditions necessary for
defining the first five terms of these series are found. An example of cal-
culation is given on the basis of these five-term expansions for the boundary
layer on a plate with the trailing segment moving at the velocity of the on-
coming flow. References 10: 5 Russian, 5 Western.

CONCERNING THE WIDTH OF A COMPRESSION WAVE FRONT IN NUCLEAR MATTER

GALITSKIY, V. M., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] The author calculates the width of the shock wave front propagat-
ing in nuclear matter in the hydrodynamic approximation, and derives expres-
sions for the change in time of the specific volume and other macroscopic
quantities in the transition layer of the compression wave with consideration
of the viscosity and heat conduction of the material. Of particular impor-
tance is the fact that the temperature of a liquid approaches zero with in-
creasing distance from the wavefront in the direction of the oncoming flow,
the coefficient of viscosity increasing as T^{-2}, while the coefficient of

heat conduction is proportional to T^{-1}. Thus the deviations from ideal behavior in this region are considerable, and accounting for viscosity is especially important. It is shown that the transition layer of the shock wave is always strongly elongated toward the incident flux. References 6: 3 Russian, 3 Western.

USSR   UDC 621.039.5

A TECHNIQUE FOR CALCULATING VELOCITY AND TEMPERATURE FIELDS WITH COMBINED ACTION OF NATURAL AND FORCED CONVECTION

Obninsk METODIKA RASCHETA POLEY SKOROSTI I TEMPERATURY PRI SOVMESTNOM DEY-STVII YESTESTVENNOY I VYNUZHDENNOY KONVEKTSII in Russian, Engineering Physics Institute FEI-668, 1976 20 pp, mimeo

MATYUSHINA, S. A., and NOMOFILOV, YE. V.

[Text] The paper describes formulation of a problem in calculation of the fields of velocity and temperature as applicable to cold traps. An algorithm is developed for numerical solution of the formulated problem. Preliminary results of the calculations are presented.

USSR   UDC 532.529+532.593

STRUCTURE OF SHOCK WAVES IN A POLYDISPERSE MIXTURE OF LIQUID AND GAS BUBBLES

Moscow IZVESTIYA AKADEMII NAUK SSSR, MEKHANIKA ZHIDKOSTI I GAZA in Russian No 6, Nov/Dec 76 pp 145-147 manuscript received 4 Feb 76

SHAGAPOV, V. SH., Ufa

[Abstract] The authors consider motion of a liquid in which gas bubbles are suspended, and investigate the structure of steady-state shock waves in such a two-phase medium in the m-velocity, m-temperature, m-pressure model $(m > 2)$. An analysis is made of the extent to which averaging is applicable, i.e., using a single bubble diameter to characterize the dispersion of the gas phase. Mass exchange between phases and compressibility of the liquid are disregarded, and the temperature of the liquid (in contrast to that of the gas bubbles) is taken as constant. It is shown that polydispersity and relative longitudinal motion (slip) of the phases in a wave with oscillation structure make the wave more "monotonic," i.e., they reduce the amplitude of pulsations of

the averaged pressure in the liquid. If thermal dissipation is accounted for, effects due to heat exchange and noncoincidence of the velocities of the phases have little influence on the distribution of pressure in the liquid in a mixture where the bubbles differ in size by a factor of no more than 1.5-2. Smaller bubbles "follow" the liquid pressure, while large ones are "pumped up" to a much greater extent than are gas bubbles in the averaged monodisperse medium. Thus for the case of polydispersity the distribution of averaged pressure in the liquid with the structure of a shock wave can be studied in the monodisperse mixture approximation with averaged bubble size. It is pointed out that pressure averaging in a liquid is a quantity that can now be measured in experiments. Figures 2; references 4 (Russian).

INVESTIGATION OF THE INFLUENCE THAT NOZZLE SHAPE HAS ON THE CHARACTERISTICS OF THREE-DIMENSIONAL SUBSONIC AND SUPERSONIC FLOWS

DVORETSKIY, V. M., Moscow

[Abstract] An analysis is made of the particulars of three-dimensional subsonic and supersonic flows of inviscid and thermally nonconductive gas in nozzles of complex shapes. The study is based on numerical integration of a system of gasdynamic equations by means of monotonic piecewise-difference schemes of the first order of accuracy. It is shown that the peculiarities of three-dimensional mixed flows depend on nozzle configuration. The results demonstrate the feasibility of modifying the distribution of characteristics of flow nonuniformity by selection of the nozzle profile. The author thanks M. Ya. Ivanov and A. N. Krayko for interest in the work and useful remarks. Figures 6; references 10: 7 Russian, 3 Western.

INVESTIGATION OF SUPERSONIC FLOW AROUND ELONGATED BLUNT BODIES WITH ELLIPTICAL CROSS SECTION

ANTONETS, A. V., and LIPNITSKIY, YU. M., Moscow

[Abstract] The authors consider effects of flow without planes of symmetry around elongated blunt bodies with cross sections that are ellipses with constant or variable ratio of the semiaxes lengthwise of the body. The gas-dynamic functions are determined in the subsonic and transonic flow region near the nose, and from the steady-state distribution of these gasdynamic functions the required initial data are found for calculation of the supersonic flow region. The calculated and experimental aerodynamic coefficients show satisfactory agreement. Figures 4; tables 3; references 12 (Russian).

INVESTIGATION OF THE DIMENSIONS OF A WAKE BEHIND A CONE FLYING AT HYPERSONIC VELOCITY

CHERNYAVSKIY, S. YU., Moscow

[Abstract] Considerable experimental research has dealt with the dimensions of wakes behind a sphere or cylinder blunted by a sphere flying in air at hypersonic velocities. Much less attention has been given to the parameters of the wake behind a cone, in particular with flight at an angle of attack. This paper gives the results of measurement of the average width of the wake and the standard deviation of the boundary of the wake for a cone flying in air with vertex half-angle of $10°$ and blunting radius of the nose section of 6% of the diameter of the base at Mach number $M = 12$ and Reynolds number $Re = 0.3 \cdot 10^6$ in the range of angles of attack of $12-24°$. The studies were done on an experimental installation consisting of a two-stage model launcher fired by light gas and a hermically sealed ballistic chamber. Shadow patterns were recorded around the model and in the wake in the direction perpendicular to the longitudinal axis of the flight path. It was found that the angle of attack has little influence on the normalized width of the wake D. Blunting increases D by 45% at $X = x/\sqrt{c_x s} \approx 200$, where x is the distance from the base in terms of its diameter, c_x is the drag of the model and s is the area of the base. The influence of blunting decreases with distance. Increasing the half-angle of the vertex of the cone causes a reduction in D when X is of the order of 600 or less. When the half-angle of the vertex is $40°$, the values

of D for a sphere and a cone coincide. For X of the order of 600 or greater, the approximate relation $D \approx 0.9X^{1/3}$ holds for all shapes investigated. This relation gives a very good description of the change in width of the wake with distance at $X = 10-4 \cdot 10^3$ for a cone with vertex half-angle of 10°. For cones with an angle of attack near zero the ratio σ/δ of the standard deviation of the wake boundary to the average width is practically constant over a range of distances of $x = (20-2000)d$, where d is the diameter of the base. This ratio is also practically constant for cones at all investigated angles of attack over a range of $x = (50-100)d$ and averages 0.33. With zero angle of attack, σ/δ increases for cones. Increasing the vertex half-angle reduces the ratio σ/δ. The author thanks N. N. Baulin for assistance with the experiments. Figures 4; references 8: 5 Russian, 3 Western.

SPATIALLY POLARIZED STRUCTURE OF GAS-IONIZING DETONATION WAVES

LEBEDEVA, L. N., Moscow   .

[Abstract] An investigation is made of the structure of ionizing detonation waves in the case where the wave is spatially polarized and both transverse components of the magnetic field vary in the structure. It is assumed that in the layer that is the wave structure, the magnetic viscosity and the reciprocal of the chemical reaction rate are much greater than the other dissipative coefficients. The conditions of existence of such a spatial structure are elucidated. The author also examines plane-polarized ionizing detonation waves with structure that is not planar. When the characteristic length of dissipation of the magnetic field is much greater or much less than the characteristic length of the chemical reaction, the auxiliary relations necessary for existence of the structure are written out in explicit form or are qualitatively studied. References 4 (Russian).

DYNAMICS OF SPHERICAL VAPOR BUBBLES IN A SUPERHEATED LIQUID

KIRICHENKO, YU. A., KRYTOV, A. V., and CHERNYAKOV, P. S., Khar'kov

[Abstract] The authors examine laminar and axisymmetric flow around a spheri-
cal bubble moving in an unbounded volume of incompressible viscous liquid for
Reynolds numbers less than 5, Prandtl numbers of the order of unity and Jacobi
numbers Ja less than $2Pr/\mathcal{K}$; it is assumed that natural convection in the
liquid can be disregarded in comparison with forced convection due to bubble
motion, and that the motion of vapor and heat transfer in the vapor can be
disregarded. It is assumed that $We < 2$. This condition implies that the bub-
ble remains spherical during motion and expansion. The rate of growth of the
bubble is taken as considerably less than the rate at which it rises in the
liquid, and the velocity and temperature of the liquid are time-independent.
Here Re = $R U_\infty / \nu$, R is the radius of the bubble, U_∞ is the rate of rise of the
bubble, ρ, ν, a, λ, c_p are the density, kinematic viscosity, temperature co-
efficient of thermal conductivity, thermal conductivity and specific heat of
the liquid, Pr = ν / a, $\mathcal{K}$ = $1 + \rho_g / \rho$, ρ_g is the density of the vapor, We = $2 \rho_g$
$U_\infty^2 R / \sigma$, σ is the coefficient of surface tension, ΔT_0 = $(T_s - T_0)/T_0$, L is the
latent heat of vaporization, T_0 and T_s are temperatures (initial and on the
saturation line) and Ja = $c_p T_0 (-\Delta T_0) \rho / L \rho_g$. Comparison of the results of cal-
culations with experimental data shows a discrepancy of 10% in radii and 40%
in velocity. Figures 4; references 20: 16 Russian, 4 Western.

FORMATION OF A QUASI-STEADY JET INSIDE A NOZZLE IN THE IMPACT STARTING PROCESS

GVOZDEVA, L. G., and ZHILIN, YU. V., Moscow

[Abstract] The authors consider interaction of a shock wave with a conver-
gent-divergent channel under flow conditions where the reversed shock wave
interacts with the boundary layer with jet formation, flow separation and
lengthening of the starting process. The case of unsteady interaction between
the shock wave and boundary layer is examined. The wave pattern is found for
impact starting of a supersonic nozzle when an overexpanded jet is formed
inside the nozzle. The results are confirmed by experimental measurements
of the pressure and temperature on the nozzle surface. An experimental re-
lation is found for the way that the criterion of separation for unsteady
interaction between the shock wave and the boundary layer depends on the

Mach number of the flow, and a comparison is made with theoretical results. The best agreement is with the Gadd criterion (G. A. Gadd, "Interaction Between Wholly Laminar or Wholly Turbulent Boundary Layers and Shock Waves Strong Enough to Cause Separation," J. Astronaut. Sci., 1953, vol 20, No 11). Figures 4; references 13: 3 Russian, 10 Western.

THE PROBLEM OF DISPERSION OF A CONICAL VOLUME OF INCANDESCENT GAS

ARKHANGEL'SKIY, N. A., and SHURSHALOV, L. V., Moscow

[Abstract] A numerical solution is found for the problem of spatial dispersion of volumes of incandescent compressed gas that initially occupy unbounded conical regions. Previous research on this question has dealt with dispersion when the gas initially occupies two-dimensional angular regions and when a spark breakdown develops in air, which corresponds to dispersion of an incandescent gas that occupies a conical region of finite length. For any instant after time zero, axisymmetric flow is two-dimensional throughout space, whereas in the planar case the region in which flow is two-dimensional and definable lies close to the corner point and in the plane of symmetry. The approach used in the spark discharge problem did not allow detailed analysis in the vicinity of the conical spark vertex at times close to time zero. In the case of breakdown caused by a luminous spark it can be assumed that the cone is sharp at time zero, and that self-similar flow occurs in the neighborhood of the cone at initial moments of time. The authors attempt to find this flow. A technique is proposed that gives a complete solution with determination of all characteristic boundaries and parameters of the flow in the two-dimensional region over a wide range of initial parameters. The proposed technique can be generalized and refined by more rigorously accounting for the properties of air at high temperatures and calculation of the emission process. The authors thank G. G. Chernyy who suggested the research topic. Figures 6; references 6 (Russian).

DISCHARGE OF AN UNDEREXPANDED JET UPSTREAM INTO A SUPERSONIC AND A SUBSONIC FLOW

KARPMAN, I. M., Moscow

[Russian abstract provided by the source]

[Text] The paper gives the results of an experimental study of the geometric structure of an opposed underexpanded jet. Flow conditions are examined for interaction of the jet with a subsonic and with a supersonic stream. It is shown that there are unstable modes of flow when an underexpanded jet discharges into a supersonic stream. Relations are proposed that define the shape of the jet in a supersonic counterflow for conditions of stable flow in a single body. A generalized relation is derived for pressure distribution on the surface of a body with a jet discharging upstream into a subsonic flow. The range of variation in the controlling parameters is: Mach number at the nozzle tip M_a = 1 and 3; Mach number of the counterstream M_{oo} = 0.6-0.9 and 2.9, degree of mismatch of the jet n = p_a/p_{oo} = 0.5-800 (p_a and p_{oo} are the static pressures at the nozzle tip and in the counterflow), specific heat ratios $\gamma_a = \gamma_{oo}$ = 1.4, and stagnation temperatures of the jet and the flow $T_{0oo} = T_{0a}$ = 290 K. Figures 6; references 5: 3 Russian, 1 Polish, 1 Western.

EQUATION OF UNSTEADY TRANSONIC FLOWS OF IDEAL GAS

SEVOST'YANOV, G. D., Saratov

[Russian abstract provided by the source]

[Text] At present there are several different equations that describe transonic unsteady vortex-free flow of a perfect gas as a function of the relations between small characteristic parameters of the flow. To extend the region of application of these equations, they are joined into a composite equation (e.g., equations for small and large Strouhal numbers are combined in the theory of wing vibrations). In this paper the author derives a more general equation for two-dimensional flow in this category using natural orthogonal coordinates $\phi\psi$ (families of equipotential lines and stream lines) without

resorting to $\mathcal{E}$-estimates, the equation containing a new nonlinear term in comparison with the composite equation. Exact solutions of the equation are found that describe unsteady transonic flows in flat nozzles. One of these solutions describes the process of establishment of balanced flow in Laval nozzles with stationary walls. Figure 1; references 4: 2 Russian, 2 Western.

CONCERNING THE PRESSURE GRADIENT AT A BREAKING POINT OR DISCONTINUITY IN THE CURVATURE OF THE OUTLINE OF BLUNT CONES AND WEDGES IN A SUPERSONIC GAS FLOW

MINOSTSEV, V. B., Moscow

[Russian abstract provided by the source]

[Text] The problem of the pressure gradient at a breaking point or discontinuity in the curvature of a blunt body in a supersonic flow is of considerable interest. Development of a considerable positive pressure gradient may be accompanied by a "hanging" shock and separation of the boundary layer in the vicinity of the point of joining of the different sections of the contour. Calculations of flow around blunt cones and wedges done by different numerical methods show that the direction and magnitude of the corresponding pressure gradient are appreciably dependent on whether the flow is two-dimensional or axisymmetric, and also on the Mach number M_{∞} of the oncoming flow, the angle of inclination β of the straight-line segment of the generatrix of the contour, the angle of rotation of the flow $\delta - \beta$ at the break point, and the type of blunting (for a blunting contour in the form of a circular arc, these quantities depend on the central angle 2θ that determines the degree of blunting in this case).

In this paper, analytical expressions are given that enable one to use the blunting and flow parameters to determine the pressure gradient at a breaking point or discontinuity in the curvature of the outline of blunt cones and wedges in a supersonic gas flow. For bodies without a break (with discontinuity of curvature) this gradient is determined from the gasdynamic functions only on the blunt surface. The numerical methods currently available enable highly accurate calculation of gasdynamic functions both on the surface and in the flow field in the case of supersonic two-dimensional flow around bodies of different shapes. However, the accuracy of flow calculation in the vicinity of singular points such as a break or discontinuity in the curvature of the contour falls off sharply, which may hinder the arrival at qualitative conclusions on the behavior of gasdynamic functions in such regions without the appropriate asymptotic studies. A good indication of the validity of numerical results is that they approach the asymptotic values, for instance with a reduction in the grid spacing or radius of the inserted rounding of the contour in the neighborhood of a singular point. The author thanks G. N. Andreyev for constructive criticism. Figures 5; references 14: 13 Russian, 1 Western.

CALCULATION OF HYSTERESIS AND FLOWRATE FLUCTUATIONS IN BASE PRESSURE IN SUPER-
SONIC PLUG NOZZLES

GOGISH, L. V., and POKROVSKIY, O. S., Moscow

[Russian abstract provided by the source]

[Text] An examination is made of the interaction between a turbulent axi-
symmetric near wake behind the face of the plug in an annular nozzle and the
supersonic annular jet escaping from this nozzle. The flow in a one-parame-
ter near wake is calculated by an integral technique, while the flow in the
inviscid jet is calculated by a continuous computation method using a mono-
tonic explicit difference scheme of the first order of accuracy. Interaction
between the inviscid and turbulent flow is determined by the thickness of
displacement of the wake. The initial conditions of the wake are determined
from integral conditions of joining with the mixing flow in the isobaric
base region. The interaction flow is described by the singular solution of
the equations that passes through a singular saddle point--the throat of the
wake. As an example, the near wake and base pressure are calculated for dif-
ferent conditions of discharge from a plug nozzle where the ratio of the out-
side to inside radius in the outlet cross section is 1.3 and the Mach num-
ber M = 2.54. The authors determine the region of hysteresis of base pres-
sure associated with the two-valued interaction flow as a consequence of a
throat in the wake inside the first or second expansions of the jet, and
find the parameters of low-frequency flowrate fluctuations of the base pres-
sure in this region. The results of the calculation agree satisfactorily
with experimental data. Figures 4; references 6: 4 Russian, 2 Western.

NUMERICAL INVESTIGATION OF NONEQUILIBRIUM HETEROGENEOUS-HOMOGENEOUS FLOW
CONDENSATION IN SUPERSONIC NOZZLES

CHIRIKHIN, A. V., Moscow

[Abstract] A system of equations is given that describes complex hetero-
homogeneous condensation of a supercolled gas for the case of arbitrary size
distribution of heterogeneous centers. On the basis of parametric calcula-
tions the author establishes peculiarities of the influence of heterogeneous
condensation on supercooling and on spontaneous condensation of the main com-
ponent; noted in particular are displacement of the homogeneous condensation
jump downstream, and the possibility of formation of purely heterogeneous

jumps. It is shown that the root-mean cube radius should be used as the
equivalent radius of the particles in the monodispersion approximation when
describing a polydispersion process. It is also found that there is a uni-
versal relation between the reduction of supercooling of the flow and the
number of heterogeneous centers. Figures 4; references 10: 8 Russian, 2
Western.

CONCERNING FORCES THAT ACT ON A WEAKLY CONDUCTIVE DIELECTRIC IN AN ELECTRIC
FIELD

NALETOVA, V. A., Moscow

[Abstract] An investigation is made of the nature of forces that act on a
weakly conductive liquid dielectric in an electric field. In the general
case a liquid dielectric is acted on by the Coulomb force associated with
the space charge, and the polarization force. In many papers the motion of
a liquid conductive dielectric has been attributed to the polarization force,
and the Coulomb force has been disregarded. It is shown in this article that
the force associated with the space charge induced by nonuniformity of con-
ductivity may be greater than or of the order of forces associated with the
polarization of the medium, and in general this force must be taken into con-
sideration when writing equations of motion in specific cases. The author
considers the forces acting on a liquid polarizable medium in an electric
field in the presence of a temperature gradient $k = \partial T/\partial x = $ const, assuming
that the liquid is incompressible and homogeneous. The steady-state problem
is considered for the sake of simplicity, assuming that electric field
strength, electric potential, velocity of the medium and temperature are
functions of x. References 9 (Russian).

ON THE THEORY OF STABILITY OF A FLOATING PLATE

VITYUK, V. F., Odessa

[Abstract] An investigation is made of the influence that an undulating bottom section has on a floating dock simulated by a plate. It is shown that the tilting moment acting on the dock from the liquid will be maximum at certain values of the parameters that characterize the displacement of the region of bottom disturbances and the depth of the body of water. References 3: 2 Russian, 1 Western.

SHOCK WAVE DAMPING IN A TWO-PHASE MEDIUM OF LIQUID AND GAS BUBBLES

GEL'FAND, B. YE., GUBANOV, A. V., GUBIN, S. A., KUDINOV, V. M., PALAMARCHUK,
B. I., PODGREBENKOV, A. L., POPOV, O. YE., and TIMOFEYEV, YE. I., Moscow,
Kiev

[Abstract] Experiments are done in connection with the damping action of air curtains. The shock wave parameter was measured in a liquid-gas bubble system in specially modified shock tubes in the three-dimensional and one-dimensional cases. Analysis of the resultant relations for pressure differential as a function of distance enables one to find the relation between the pressure differential on the shock front, the weight of the explosive charge and the distance of a known concentration of gas bubbles in the liquid. Relations are given that generalize the experimental data for the case of spherical shock waves. Interpretation of the results shows that when an explosive charge is detonated in a two-phase medium the formation of the shock wave has a number of peculiarities. There is a difference in the behavior of the gas bubble of the products of explosion in such a medium. The particulars of oscillations of the gas cavity after an explosion need to be more thoroughly investigated for the two-phase liquid. A detailed analysis of the separation of the total energy converted into shock wave energy and into the energy of the bubble could explain the observed peculiarities of formation of shock waves in a two-phase gas-liquid medium. More study is also needed on the way that the initial pressure influences damping of shock waves in a two-phase medium. The authors thank S. V. Khomik for assisting with the experiments, and R. I. Nigmatulin for constructive criticism. Figures 4; references 7: 6 Russian, 1 Western.

LAMINAR FLOWS IN THE GAP BETWEEN POROUS DISKS IN THE CASE OF INTENSE HOMOGENEOUS ASYMMETRIC SUCTION AND INJECTION

LYUBIN, L. YA., Moscow

[Abstract] The author considers flow of an incompressible fluid between two horizontal porous disks. The problem is described in dimensionless form by equations of motion and continuity, and boundary conditions

$$v \frac{\partial v}{\partial r} + w \frac{\partial v}{\partial z} = -\frac{\partial p}{\partial r} + \frac{1}{R} \left\{ \frac{\partial^2 v}{\partial z^2} + \frac{\partial}{\partial r} \left[\frac{1}{r} \frac{\partial}{\partial r}(rv) \right] \right\}$$

$$v \frac{\partial w}{\partial r} + w \frac{\partial w}{\partial z} = -\frac{\partial p}{\partial z} + \frac{1}{R} \left\{ \frac{\partial^2 w}{\partial z^2} + \frac{1}{r} \frac{\partial}{\partial r} \left(r \frac{\partial w}{\partial r} \right) \right\}$$

$$\frac{1}{r} \frac{\partial}{\partial r}(rv) + \frac{\partial w}{\partial z} = 0$$

$$w = \text{sign } w_*^\circ, \ v = 0, \ z = 0; \ w = \chi, \ v = 0, \ z = 2$$

$$R = -\rho_* w_*^\circ h_* / \mu_*, \ v = v_* / |w_*^\circ|, \ w = w_* / |w_*^\circ|$$

$$r = r_* / h_*, \ z = z_* / h_*, \ p = p_* / \rho_* (w_*^\circ)^2$$

Here μ_* is viscosity, $2h_*$ is the distance between the disks, r_*, z_* are cylindrical coordinates with origin in the center of the lower disk, v_*, w_* are the radial and transverse components of velocity, p_* is pressure and ρ_* is density. The intensities of suction (injection) are characterized by the transverse velocity component on the surface of the lower disk w_*° and by the dimensionless parameter $x = w(2)$. Thus for the case of suction or injection from below $R > 0, w_*^\circ < 0$ or $R < 0, w_*^\circ > 0$ respectively. Suction or injection from above is characterized by the values $R_1 = x |R| > 0$ or $R_1 < 0$. The boundary conditions on the gap contour are assumed to be homogeneous, and the radius of the disks is taken as infinite. The nature of the asymptotic behavior (quantity, thickness and position of the boundary layers) depends on the parameters R, R_1. The author examines the asymptotic expansion of the solution that corresponds to regions $R \gg R^* \gg 1$, $R_1 \gg R_1^* \gg 1$ where flows are due to large injection from both sides, and to regions $R \leqslant R^*$, $R_1 \leqslant 0$ where flows are due to intense suction through the lower disk and injection of any intensity through the upper disk, the boundary $R_1 = 0$ corresponding to an impermeable upper disk. Figures 3; references 8: 5 Russian, 3 Western.

ON EQUATIONS AND FORMS OF FLOW FOR JETS INCIDENT ON A LIQUID

TSEL'NIK, D. S., Moscow

[Abstract] The author considers the problem of incidence of a flat jet of
inviscid, incompressible, imponderable fluid of density ρ_1 from a nozzle of
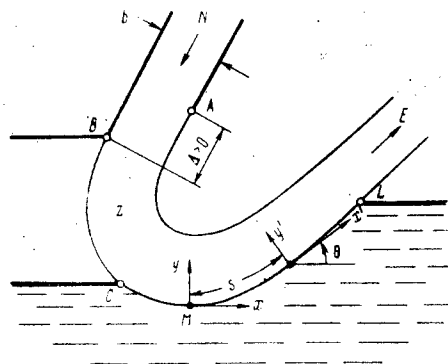width b against the surface of a stationary heavy liquid of density ρ_2 as
shown in figure 1.

Fig. 1

Velocities and pressure in N, on BC and on AE are denoted respectively by
v_∞, p_∞; v_0, p_0 and v_1, p_1. Let w be the complex potential, v -- the moculus
of velocity, θ -- the angle of the velocity vector with the x-axis, g -- the
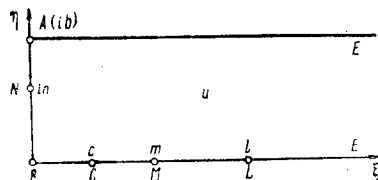acceleration due to gravity, and u -- the complex parametric variable of
figure 2.

Fig. 2

The equations of the problem are

$$\omega(u) = i \ln\left(\frac{dw}{v_1 \, dz}\right) = \theta + i\tau, \quad \tau = \ln V, \quad V = \frac{v}{v_1}\left(V_\infty = \frac{v_\infty}{v_1}, \ldots\right)$$

$$\omega(u) = \theta_\infty + \frac{1}{2b}\int_{-l}^{+l} \tau(\varepsilon)\,\mathrm{cth}\,\frac{\pi(\varepsilon-u)}{2b}\,d\varepsilon, \quad \theta_\infty = \theta(N)$$

$$(1.1) \qquad \theta(\xi) = \theta_\infty + \frac{1}{2b}\int_{-l}^{+l} \tau(\varepsilon)\,\mathrm{cth}\,\frac{\pi(\varepsilon-\xi)}{2b}\,d\varepsilon$$

$$(1.2) \qquad \theta(\xi) = \frac{1}{\pi} \int_{c}^{l} \tau'(\varepsilon) [K(\xi, \varepsilon) - K(m, \varepsilon)] d\varepsilon$$
$$(c \leqslant \xi \leqslant l)$$

$$K(\xi, \varepsilon) = \ln \frac{\mathrm{sh}[\pi(\xi + \varepsilon)/2b]}{\mathrm{sh}[\pi|\xi - \varepsilon|/2b]}$$

$$\frac{dz}{du} = V_\infty e^{-\tau + i\theta} f(u), \quad f(u) = \frac{\mathrm{sh}(\pi u/b)}{\mathrm{ch}(\pi u/b) - \cos(\pi n/b)}$$

$$(1.3) \qquad \tau'(\varepsilon) = \pi \lambda f(\varepsilon) \sin \theta(\varepsilon) e^{-3\tau(r)}, \qquad (c \leqslant \varepsilon \leqslant l)$$
$$\lambda = (bV_\infty^3/\pi)\nu, \qquad \nu = \rho_2 g / b \rho_1 v_\infty^2$$

In these equations there are five free dimensionless parameters n/b, c/b, l/b, m/b and λb. These give five dimensionless parameters, for instance

$$\frac{\Delta}{v}, \quad \frac{y(B) - y(L)}{b}, \quad \theta_\infty, \quad \nu b^2, \quad \frac{p_\infty - p_1}{\rho_1 v_\infty^2}$$

or with the substitution [y(B) - y(L)]/b on $(p_0 - p_1)/\rho_1 v_\infty^2$ that define the flow in the physical plane. Asymptotic relations are derived for calculation of the flow pattern, and examples of application are given. Figures 3; references 7: 6 Russian, 1 Western.

ASYMPTOTIC SOLUTIONS OF NON-SELF-SIMILAR BOUNDARY LAYER EQUATIONS

SHAL'MAN, YE. YU., Moscow

[Abstract] Asymptotic solutions close to the external boundary are found for non-self-similar equations of a laminar boundary layer in an incompressible liquid and a compressible gas. In the selected coordinate system the x-axis is parallel to the surface over which the flow takes place, and the y-axis is normal to the surface. The equations take the form

$$\ldots \left(N \frac{\partial^2 f}{\partial z^2}\right) + f \frac{\partial^2 f}{\partial z^2} + \beta \left(g - \left(\frac{\partial f}{\partial z}\right)^2\right) = 2\xi \left(\frac{\partial f}{\partial z} \frac{\partial^2 f}{\partial z\, \partial\xi} - \frac{\partial}{\partial z^2} \frac{\partial f}{\partial\xi}\right)$$

$$\frac{1}{\mathrm{Pr}} \frac{\partial}{\partial z}\left(N \frac{\partial g}{\partial z}\right) + f \frac{\partial g}{\partial z} + 2\frac{\mathrm{Pr}-1}{\mathrm{Pr}} U \frac{\partial}{\partial z}\left(N \frac{\partial f}{\partial z} \frac{\partial^2 f}{\partial z^2}\right) =$$

$$= 2\xi \left(\frac{\partial f}{\partial z} \frac{\partial g}{\partial\xi} - \frac{\partial g}{\partial z} \frac{\partial f}{\partial\xi}\right)$$

$$\gamma = \int_v^x \rho_e\mu_e u_e\, dx, \quad z = \frac{u_e}{\sqrt{2\xi}}\int_0^y \rho\, dy$$

$$N = \frac{\rho\mu}{\rho_e\mu_e}, \quad f = \int_0^z \frac{u}{u_e}\, dz, \quad g = \frac{H}{H_e}, \quad \beta = \frac{1}{1-U} \frac{2\xi}{u_e} \frac{du_e}{d\xi}, \quad U = \frac{u_e{}^2}{2H_e}$$

where u is the projection of velocity on the x-axis, ρ is density, μ is the coefficient of viscosity, H is stagnation enthalpy, Pr is the Prandtl number and the subscript e denotes parameters of the external flow. The boundary conditions are

$$f = \frac{\partial f}{\partial z} = 0, \quad g = g_w \quad (z=0); \quad \frac{\partial f}{\partial z} \to 1, \quad g \to 1 \quad (z \to \infty)$$

It is shown that the nature of the asymptotic solution is determined by the form of the initial velocity profile and enthalpy. The author thanks N. M. Belyanin and F. A. Slobodkina for interest in the work and discussion of the results. References 7: 5 Russian, 2 Western.

ON SOME FORMS OF LOCAL SELF-SIMILARITY OF THE VELOCITY FIELD OF TURBULENT FLOWS NEAR A WALL

KOROTKOV, B. N., Leningrad

[Russian abstract provided by the source]

[Text] Dimensional analysis and an approach used by Millikan for analysis of average motion are applied to investigation of pulsation motion of three types of flows of incompressible fluid near a wall--in the boundary layer for longitudinal flow around a plate, in a circular pipe and in a flat channel. It is shown that when the Reynolds numbers are sufficiently large there is a range of distances from the wall x_2 within which integral one-point correlations and narrow-band one-point correlations ϕ_{jk} do not depend on x_2. In the frequency space there is a hyperbolic interval in which $\phi_{jk} = A_{jk}u_\tau^2 f^{-1}$. Here

A_{jk} = const, u_τ is dynamic velocity, f is frequency. It is also shown that

from the standpoint of average motion it is necessary to distinguish von Karman
turbulent flow at fairly large Reynolds numbers from non-von Karman flow at
small but "turbulent" Reynolds numbers. In the latter case the coefficients
in logarithmic velocity profiles and in the law of drag depend on the Reynolds
number. An estimate is made of the Reynolds number that can be considered
sufficiently large. The author thanks M. A. Kashina for furnishing the ex-
perimental data. Figures 2; references 8: 5 Russian, 3 Western.

DYNAMICS OF VAPOR-GAS BUBBLES

NIGMATULIN, R. I., and KHABEYEV, N. S., Moscow

[Abstract] The authors examine the problem of thermal, mass and dynamic in-
teraction between a gas-vapor bubble and a liquid. Results are given per-
taining to numerical solution of the problem of radial motion of a bubble due
to a sudden change in liquid pressure, which illustrates the behavior of
vapor-gas bubbles in compression and rarefaction waves. Figures 6; refer-
ences 7: 6 Russian, 1 Western.

MOTION OF A SOLITON AND PERIODIC WAVES WITH AMPLITUDE CLOSE TO THE LIMITING
VALUE IN A LIQUID LAYER OF SLOWLY VARYING DEPTH

KULIKOVSKIY, A. G., and REUTOV, V. A., Moscow

[Abstract] The authors consider motion of a weakly curved solitary wave with
slowly varying amplitude on the surface of a layer of ideal fluid of slowly
varying depth. As the wave moves, it may happen that part of the wave has the
limiting amplitude of about 80% of the unperturbed depth, while part of it
has an amplitude less than the limiting value. The two parts of the wave are
described by different systems of equations, and the boundary separating them
is treated as a discontinuity surface. This surface is constructed and its
behavior is studied, conditions of evolution are indicated, the structure of
the surface is examined, and interfaces are classified. Problems of the motion

of interfaces are considered, and in particular in the vicinity of points where one type of interface is replaced by another. The results of numerical calculation of some problems are discussed. The authors thank A. A. Barmin for discussion of the work and constructive criticism. Figures 5; references 8: 5 Russian, 3 Western.

UNSTEADY WAVES IN A CONTINUOUSLY STRATIFIED FLUID FLOW OF FINITE DEPTH

DOTSENKO, S. F., and CHERKESOV, L. V., Sevastopol'

[Abstract] A theoretical investigation is made of the development of two-dimensional linear waves in a continuously stratified flow of ideal incompressible fluid. The waves are generated by time-independent pressures applied at time zero to a bounded region of the free surface of an initially unperturbed flow. Figures 2; references 11: 9 Russian, 2 Western.
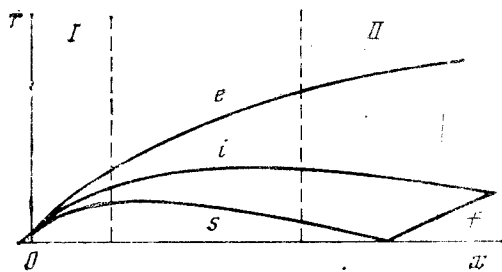
SELF-SIMILAR REPRESENTATION OF THE STRUCTURE OF A GASDYNAMIC REGION WHEN A STRONGLY UNDEREXPANDED GAS JET DISCHARGES INTO AN ACCOMPANYING HYPERSONIC FLOW

KHRAMOV, G. A., and CHEKMAREV, S. F., Novosibirsk

[Abstract] To solve certain problems involving the discharge of a strongly underexpanded axisymmetric gas jet into an accompanying hypersonic flow it is necessary to know the position of surfaces of strong discontinuity that determine the structure of the gasdynamic region in this case. For each specific set of defining parameters the position of the surfaces can be found by one of the following methods: direct numerical solution of the problem including calculation of the flow field, approximate solution, or by means of "universal" curves obtained by generalizing data of numerical calculations or experimental data. Such curves have been found previously for the flow region adjacent to the tip of a nozzle and extending downstream no further than the range of applicability of the newtonian approximation for the pressure of the accompanying flow against the boundary of the jet. In this paper

it is shown that the scales of the gasdynamic region in the vicinity of in-
cidence of a hanging shock on the axis of a jet differ from the corresponding
scales in the previously studied flow region, and as a result the initial
section of the jet cannot be characterized anywhere by unified (constant)
linear scales. Localized scales are introduced and used to get a self-similar
representation for the position of the surfaces of strong discontinuity over
the length of the initial section of the jet. The structure of the gas-
dynamic region on the initial section is determined by the position of the
four surfaces of strong discontinuity shown in the figure: the contact sur-
face separating the jet from the accompanying flow (i), the shock wave in

the accompanying flow (e), the hanging (s) and reflected (f) shock waves
inside the jet. In dimensionless coordinates x/R_c where R_c is the radius of
the nozzle tip, the position of these surfaces is determined if we know the
half-angle of the nozzle orifice taper θ_c, the ratios of the heat capacities
of the gas in the jet K_c and in the accompanying flow K_{∞} the Mach numbers
at the nozzle tip M_c and in the accompanying flow M_{∞} and the ratio of the
pressure at the nozzle tip to that in the accompanying flow $n \simeq p_c/p_{\infty}$ The
authors consider the case $M_c^2 \gg 1$, $M_{\infty}^2 \gg 1$, $n \gg 1$ and $\theta_c \ll \theta_*$ is the limiting
angle of turn of the flow for the given M_c as the gas expands into vacuum.
It is shown that the scales for the shock wave in the accompanying flow co-
incide in regions I and II, and also in the intermediate region. The authors
thank S. S. Kutateladze and A. K. Rebrov for useful discussions. Figures 4;
references 6 (Russian).

INFLUENCE THAT A CONICAL BREAK IN DELTA WINGS HAS ON AERODYNAMIC CHARACTER-
ISTICS

GONOR, A. L., KRAVETS, V. V., and SHVETS, A. I., Moscow, Dnepropetrovsk

[Abstract] The paper gives the results of experimental studies of the aero-
dynamic coefficients and the pressure on the windward side of delta wings
with a conical break. The lift-drag ratios of delta wings with a conical

break are compared with models of a wing-cone configuration with symmetric caret design at a Mach number M = 5.96. Figures 5; references 11: 6 Russian, 5 Western.

VIBRATIONAL-DISSOCIATION RELAXATION OF NITROGEN IN A HYPERSONIC SHOCK LAYER AT MODERATE REYNOLDS NUMBERS

ZALOGIN, G. N., Moscow

[Abstract] Based on a numerical solution of simplified Navier-Stokes equations the author investigates one-dimensional relaxation of vibrational degrees of freedom of molecules, dissociation and ionization in a shock layer with hypersonic flow of nitrogen around a blunt body in the vicinity of the critical stream line. The analysis is based on a gasdynamic model that accounts for the structure of the viscous compression shock, which permits investigation of the influence of nonequilibrium processes in the neighborhood of the shock wave. A study is made of the influence that the process of vibrational-dissociation interaction has on the structure of the shock layer, the specific heat fluxes to the wall and the distribution of electron concentrations in the shock layer. It is shown that at hypersonic flight speeds this process has the maximum effect on the shock wave structure under conditions that correspond to moderate Reynolds numbers, where transport effects play an appreciable part. The author thanks V. V. Luner and V. G. Voronkin for advice and discussion. Figures 5; references 9: 7 Russian, 2 Western.

PARTICULARS OF EXPERIMENTAL STUDIES OF A HIGH-TEMPERATURE GAS FLOW ON INSTAL-
LATIONS WITH AN ELECTRIC-ARC HEATER

SEPP, V. A., Moscow

[Abstract] The paper gives the results of experimental studies of high-
temperature flows where an electric-arc heater is used as the source of therm-
al energy. The experimental method permits measurement of gasdynamic param-
eters at a pressure of 1 atmosphere and temperature of 3000 K. It is shown
that it should be feasible to do detailed experimental research on installa-
tions with a plasmotron. An examiation is made of the development of flow in
the region of transition from a zone where the channel has cooled metal walls
to a zone where the walls are rough ceramic. Figures 5; references 14
(Russian).

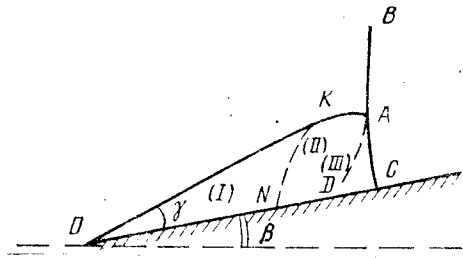CONCERNING IRREGULAR INTERACTION OF A STRONG SHOCK WAVE WITH A THIN CONE

BOGATKO, V. I., and KOLTON, G. A., Leningrad

[Abstract] The authors consider the axisymmetric problem of Mach reflection
of an intense shock wave from the surface of a thin cone. It is assumed
that a plane shock wave with characteristic ratio of densities on the wave
front $\varepsilon \ll 1$ is incident on a cone with vertex half-angle β. The velocity N_0
of displacement of the surface of the shock wave front is parallel to the
axis of symmetry of the cone. The nature of the flow and the configuration
of the discontinuity surfaces in the perturbed region depend appreciably on
the ratio of the orders of the small parameters of the problem β and ε. It
is assumed that $\beta = 0(\varepsilon)$, i.e., $\beta = \beta_0 \varepsilon$, where $\beta_0 = 0(1)$. In this case the
incident shock wave interacts irregularly with the surface of the cone, and
the reflected shock wave is attached to its vertex. A diagram of the flow
in the meridian plane is shown in the figure. Here BA is the front of the
unperturbed shock wave, AC is the Mach wave, OKA is the front of the reflected
shock wave, and AD is the tangential discontinuity. Behind the straight-line
section OK of the reflected shock wave front in region OKN, conical flow
takes place. The boundary KN of this flow in the plane of self-similar vari-
ables is a line of parabolicity of a system of gasdynamic equations. The

boundary value problem for the shape of the Mach wave front is formulated and numerically solved on a computer. The authors thank A. A. Grib for discussion of the work and constructive criticism. Figures 3; references 6 (Russian).

STABILITY OF A SUPERSONIC BOUNDARY LAYER ON A PERMEABLE SURFACE WITH HEAT EXCHANGE

GAPONOV, S. A., Novosibirsk

[Abstract] An investigation is made of the influence that cooling of a permeable surface has on the stability of a supersonic boundary layer on the surface. Stability of the boundary layer is examined relative to infinitely small perturbations of the form g(y)exp[ia(x - ct)] with amplitudes satisfying the Dunn-Lin equations [D. W. Dunn, C. C. Lin, "On the Stability of the Laminar Boundary Layer in a Compressible Fluid," J. Astronaut. Sci., 1955, vol 22, No 7]. The dynamic viscosity is assumed to linearly dependent on temperature, and the Prandtl number is taken as equal to unity. Only two-dimensional perturbations are studied in detail. It was found that the critical Reynolds number R_* does not become infinite at any dimensionless wall temperature T_w, i.e., the boundary layer is not completely stabilized by cooling even in the case of two-dimensional perturbations. In fact, there is even a reduction in stability with surface cooling in the low-temperature region. The results also show that the region of stability parameters may have common points of continuous and discrete spectra for finite Reynolds numbers in the supersonic boundary layer. The work was done at the Department of Applied Mathematics of the University of Western Ontario in Canada. The author thanks the department chairman Professor D. Blackwell for suggesting investigation of this problem. Figures 3; references 13: 7 Russian, 6 Western.

CALCULATION OF A TURBULENT JET DIFFUSION FLAME WITH CONSIDERATION OF CONCENTRA-
TION PULSATIONS AND ARCHIMEDEAN FORCES

KUZNETSOV, V. R., LEBEDEV, A. B., SEKUNDOV, A. N., and SMIRNOVA, I. P., Moscow

[Abstract] Equations of the traditional semi-empirical theories of turbulence
are generally derived for incompressible fluid flows, so that generalization
to diffusion combustion involves certain difficulties. Among these is the
fact that heat release may have a considerable influence on the dynamic struc-
ture of turbulence, and the values of the empirical constants in the equations
may change. Besides, large density gradients that arise during combustion
mean that Archimedean forces become a considerable factor. And another fac-
tor that becomes important in diffusion combustion is fluctuations in concen-
tration. This paper offers a new semi-empirical turbulence model suitable
for calculating mixing processes in isothermal flows as well as the charac-
teristics of diffusion combustion. Calculations by the proposed equations
qualitatively confirm experimental data that show a greater coefficient of
turbulent diffusion in a jet diffusion flame than in the case without combus-
tion. Archimedean forces are found to have a considerable influence on
velocity and turbulent viscosity. Lift appreciably increases velocity on the
axis of the jet. These forces also increase turbulent viscosity and cause a
rise in this parameter lengthwise of the jet. The Froude number also has a
considerable effect on the length of the jet. Studies of hydrogen concentra-
tion show that with increasing Froude number there is a reduction in concentra-
tion along the jet that approaches zero asymptotically as distance approaches
infinity. Comparison of theory with experiment shows that heat release from
chemical reactions is relatively unimportant. Figures 6; references 20:
12 Russian, 8 Western.

VISCOSITY OF CRYOGENIC SUBSTANCES UNDER PRESSURE (SURVEY)

RUDENKO, N. S., and SLYUSAR', V. P.

[Text] The survey discusses published data on the viscosity of hydrogen,
deuterohydrogen, deuterium, neon, argon, krypton, xenon, nitrogen, and methane

under pressure and at temperatures ranging from their respective tripe points
to 300 K. Rounded off values of the viscosity of these substances have been
tabulated versus temperature, pressure, and density.

AL'TSHULER, L. V., KAPEL', G. I., and CHEKIN, B. S., All-Union Scientific Re-
search Institute of Optico-Physics Measurements

[Russian abstract provided by the source]

[Text] The authors discuss a new method for measuring the viscosity of shock-
compressed dielectrics, based on the magnetoelectric registration of the ve-
locity of cylindrical conductors behind the front of shock waves. They de-
termine the viscosity of water at pressures of 30 and 80 kbar. The values
found for the viscosities, in the range of hundreds and thousands of poises,
are five orders of magnitude greater than the viscosity of water under normal
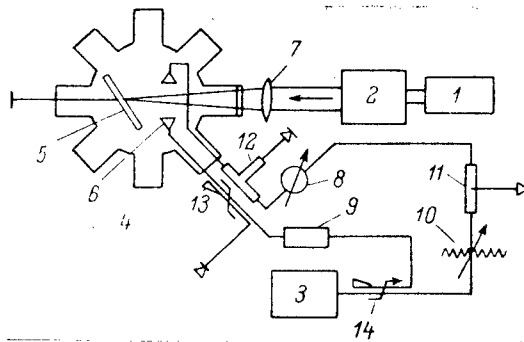conditions. Figures 2; table 1; references 14: 8 Russian, 6 Western.

USSR   UDC 533.9.07

MICROWAVE MEASUREMENTS OF A LASER PLASMA

CHERNYSHEV, L. YE., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Abstract] Mach-Zehnder interferometry is used to study a laser plasma. The emission from a klystron microwave oscillator (λ = 11 mm) is split into reference and measurement channels. A phase difference between the signals in these channels is set up by the plasma when it passes through a 4 cm gap between two horn antennas (see figure). In addition, the plasma transmission and reflection signal was measured. In this way, the microwave absorption in the plasma and the microwave reflectance can be determined. The plasma was produced by focusing neodymium laser emission on an aluminum target. The profiles of electron concentrations in space are plotted for different laser energies at different elapsed times. The experimental plasma behavior is satisfactorily explained by the proposed theory. The computational model takes consideration of the fact that the rate of dispersion of the plasma produced at different points of the laser pulse is different. Therefore the observed spatial profiles of electron density are determined to a great extent by the shape of the laser pulse in time. References 8: 2 Russian, 6 Western.

USSR

ON THE THEORY OF THE PHOTON SPECTRUM IN A SEMICONDUCTOR LASER

YELESIN, V. F., and KOPAYEV, YU. V., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The spectrum of supercondensate photons is found in a semiconductor laser far beyond the threshold of stimulated emission. Supercondensate photons appear due to the interaction between condensate photons (via the electron system). This effect is analogous to "squeezing" of particles out of a

non-ideal Bose condensate. However, in contrast to the case of an equilibrium non-ideal Bose gas, the number of supercondensate photons increases with time. The instability of the photon condensate in the laser is due to the fact that processes of production of supercondensate photons from the condensate are realized. References 10: 8 Russian, 2 Western.

USSR

ABSORPTION AND REFLECTION OF LASER EMISSION EMANATED BY A DISPERSING HIGH-TEMPERATURE PLASMA

AFANAS'YEV, YU. V., DEMCHENKO, N. N., KROKHIN, O. N., and ROZANOV, V. B., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The authors examine the two-dimensional self-consistent problem of absorption and reflection of incident radiation emitted by a dispersing high-temperature plasma. The process of interaction of the radiation with matter is described within the framework of Maxwell's equations for the field of a light wave and gasdynamic equations with electronic heat conduction. A numerical solution of these equations is given for a plane layer of plasma over a wide range of flux densities and at different laser pulse durations. Emphasis is placed on investigation of the contribution that the energy of lasing action makes to the plasma. The calculations are done both on the assumption of a retarding mechanism of absorption and with consideration of a number of collective processes. References 13: 11 Russian, 2 Western.
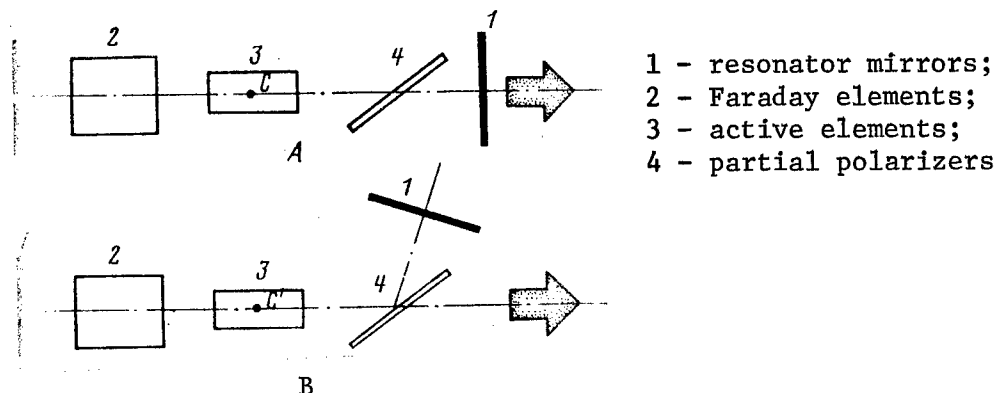
USSR   UDC 621.378.32

A LASER WITH DYNAMIC TUNING OF EMISSION POLARIZATION

ZHELTOV, G. I., RUBANOV, A. S., POLKANOV, YU. A., and BOKHONOV, A. F.

[Abstract] An attempt is made to accomplish dynamic control of the polarization vector of laser emission while simultaneously regularizing the time structure. The laser cavities used in the experiment are diagrammed in the figure. Both include a Faraday element and a partial polarizer (inclined plane-parallel glass plate).

1 - resonator mirrors;
2 - Faraday elements;
3 - active elements;
4 - partial polarizers

The natural polarizations of these cavities are linear when the condition

$$\tan 2\theta \leqslant \frac{1-\xi_i^2}{2\xi_i} \quad (i = 1,\ 2)$$

is satisfied, where θ is the angle of rotation of the plane of emission polarization by the Faraday element, and

$$\xi_1 = \frac{P_1}{P_2} \quad \text{for arrangement A,}$$

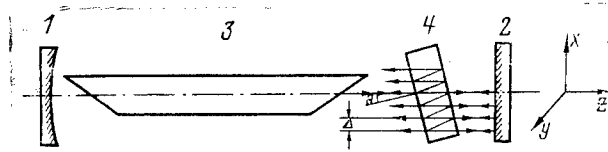$$\xi_2 = \frac{R_2}{R_1} \quad \text{for arrangement B,}$$

P_1 (R_1) and P_2 (R_2) is the transmittance (reflectance) of the inclined plate for emission polarized perpendicular to and parallel to the plane of incidence respectively. The azimuth of emission polarization ϕ is a function of θ. The maximum change of ϕ inside the cavity (points C and C' in the figure) for inherent linear polarization having the least losses is given by the relation $\tan \phi_{max} = \pm 1/\xi$. Arrangement A gives comparatively high laser efficiency, but has a fundamental limitation on the azimuth of polarization of the output emission, whereas arrangement B would enable control of the polarization azimuth close to $\pm 90°$. Experimental results confirm the feasibility of polarization azimuth tuning and regularization of the time structure of stimulated emission. Further research is needed on problems relating to optimization of hardware, examination of the principles governing emission kinetics and selection of laser operating conditions. References 3 (Russian).

USSR

RESONATOR LOSSES IN A LASER WITH INCLINED FABRY-PEROT ETALON AS THE FREQUENCY
SELECTOR

KOROLEV, F. A., GRIN', L. YE., KOROLENKO, P. V., LEBEDEV, V. V., ODINTSOV, A.
I., and SARKAROV, N. E.

[Abstract] The authors calculate the losses introduced in a laser cavity by
an inclined Fabry-Perot etalon for the fundamental mode. The optical arrange-
ment of the laser system is shown in the figure.

1--spherical mirror; 2--flat mirror; 3--laser tube;
4--Fabry-Perot etalon

It is assumed that only the fundamental mode TEM_{00} can be stimulated in the
cavity. The gaussian beam passes through the etalon, is reflected from the
flat mirror, and is multiply transmitted through the etalon, forming a sym-
metric system of gaussian beams that are relatively displaced in the trans-
verse direction with sequentially damped amplitudes. The amount of displace-
ment Δ depends on the angle of inclination θ between the etalon and the cavity
axis, the thickness of the etalon d, and the index of refraction n. There is
also a system of inclined beams propagating at angles $\pm 2\theta$ to the axis of the
cavity. An analytical formula is derived for the losses in this system, and
numerical calculations are given. The influence of nonparallelism in the
faces of the Fabry-Perot etalon is considered. It is shown that for an angle
of 2" of taper between the faces of the etalon the additional losses are in-
significant. A formula is given for calculating losses due to absorption and
scattering in the etalon mirrors. The theoretical results are compared with
experimental data for an argon ion laser. Good agreement was observed. The
experiments showed that introduced losses are nearly independent of whether
the etalon is placed close to the flat or the spherical mirror. It is sug-
gested that the increase in beam diameter is balanced out by the additional
losses that arise due to wavefront mismatch of the beams. The main results
of this work were reported in a paper delivered to the second regional semi-
nar "Gas Lasers on Vapors of Chemical Elements" at Rostov-na-Donu, September
1973. References 15: 3 Russian, 12 Western.

PARTICULARS OF THE STRUCTURE OF HARMONICS $2\omega_0$ AND $3\omega_0/2$ GENERATED IN A LASER PLASMA

ALEKSANDROV, V. V., VIKHAREV, V. D., ZOTOV, V. P., KOVAL'SKIY, N. G., and PERGAMENT, M. I.

[Abstract] The paper gives experimental results on the spectral composition, time characteristics and angle relations of emission on frequencies of $2\omega_0$ and $3\omega_0/2$ (ω_0 is the working frequency of the laser) scattered by the plasma that is produced when a neodymium laser beam is focused on flat polyethylene and aluminum targets. The density of the light flux in the 3.5 ns pulse was $2 \cdot 10^{13}$-$2 \cdot 10^{14}$ W/cm^2. The spectrum of scattered emission was measured in directions of 180, 135 and 90° to the axis of normal incidence, and also in the case where the surface of the target was at an angle of 45° to the laser beam. Emission on harmonic $3\omega_0/2$ showed a component shifted toward longer wavelengths in addition to the maximum corresponding to the line position. Scattering on this frequency with normal incidence was highly anisotropic, and the harmonic was not recorded at an angle of 90° to the angle of incidence. The distance between line components for this harmonic was 1.5 times less for scattering at 135° than for backscattering at 180°. When the laser beam was 45° to the surface of the target, a bright line was observed on $3\omega_0/2$ at all three scattering angles, and line splitting was small in all cases. With oblique incidence, reflection on the fundamental frequency falls off in the aperture of the focusing lens, most of the reflected emission going in the direction of mirror reflection. When the beam is 45° to the target, the line for $2\omega_0$ practically disappears. There is a time displacement of $(0.5-1) \cdot 10^{-9}$ s between the reflected pulse on the fundamental frequency and on the harmonics. The results are of interest for laser-driven thermonuclear fusion. References 4: 2 Russian, 2 Western.

AN ULTRAVIOLET NITROGEN LASER ON 337.1 nm WITH HIGH PULSE RECURRENCE RATE

SHUAIBOV, A. K., and SHEVERA, V. S., Uzhgorod State University

[Abstract] A report on stimulation of superluminescence in a flat-line double pulse shaper on transitions of the second positive system of nitrogen with emission pulse recurrence rate of 20-30 Hz. The high recurrence rate was realized in a shaper line measuring 150 x 400 mm by using a single asymmetrically placed high-pressure gas discharger (10-20 atm of N_2 or Ar). Polyethylene films with total thickness of 1 mm were used as the dielectric in the line. The pulse recurrence rate was controlled by varying the charging voltage and resistance. Under optimum conditions the laser cell was 150 mm long and the channel cross section was 0.05 x 12 mm. The electrodes of the working channel were made from 0.03 mm copper foil. Nitrogen was pumped through at a pressure of 400 mm Hg. The discharge current pulse as measured by a Rogowski loop was 1.6 kA at a charging voltage of 22 kV. The discharge emission was coupled out through a quartz window and recorded by an FEK-22 coaxial photocell and an S8-2 oscilloscope. A pulse energy of 2.5 mJ was achieved at a nitrogen pressure of 200 mm Hg in the laser cell. Conversion efficiency was 2%. The stimulated ultraviolet emission has a wavelength of 337.1 nm. References 7: 4 Russian, 3 Western.

INVESTIGATION OF THE CHEMICAL COMPOSITION OF THE GAS DISCHARGE PLASMA OF A
CO LASER AT ROOM TEMPERATURE

VOLCHENOK, V. I., YEGOROV, N. P., KOMAROV, V. N., KUPRIYANOV, S. YE., OCHKIN, V. N., SOBOLEV, N. N., and TRUBACHEYEV, E. A., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Russian abstract provided by the source]

[Text] An investigation is made of the neutral and ionic makeup of the active substance of a CO laser as a function of the initial composition of the gas mixture, the pressure, and the discharge conditions with continuous pumping of gas through the discharge gap. The laser emission power was recorded in parallel with mass-spectrometric measurements. A study of chemical transformations from the standpoint of the balance of elements shows that in mixtures that do not contain oxygen the decrease in carbon monoxide is due

to dissociation by direct electron impact $CO + e \rightarrow C + O + e$. The part played by the reaction CO $(a^3\Pi) + CO \rightarrow CO_2 + C$ and heterogeneous processes is discussed. In mixtures with additives of O_2, chemical processes are influenced by the reaction $CO + (1/2) O_2 \rightarrow CO_2$. The addition of xenon to the mixture reduces the formation of CO_2 and losses of CO. The addition of nitrogen has no appreciable effect on chemical processes in the plasma. The principal ions in a Co-He mixture are CO^+, CO_2^+. $C_2O_2^+$ and C^+. Ions of $C_3O_2^+$ and C_2O^+ were also observed. The most intense peak is from O_2^+ in mixtures with O_2 additives. If the mixture contains xenon, this gas shows up as the most intense peak in the ion spectrum. References 28: 14 Russian, 14 Western.

LOPASOV, V. P., and MAKOGON, M. M.

[Text] An analysis is made of operation and classification of modes of emission of sweep lasers; different types of electro-optical interference-polarization filters are considered, and the effectiveness of controlling stimulated emission by using such filters is demonstrated. Laser emission modes are determined for solving a number of problems in laser spectroscopy.

USSR   UDC   535.33:621.375.8;535:530.182;778.38

A TECHNIQUE FOR INSPECTING AND SELECTING OPTICAL ELEMENTS FOR MULTICHANNEL
HIGH-POWER LASER INSTALLATIONS

Moscow METODIKA KONTROLYA I OTBORA OPTICHESKIKH ELEMENTOV DLYA MOSHCHNYKH
MNOGOKANAL'NYKH LAZERNYKH USTANOVOK in Russian, Physics Institute, Academy of
Sciences USSR, Quantum Radiophysics, Preprint No 115, 1976, 21 pp, mimeo.

DANILOV, A. YE., MAGNITSKIY, S. A., MIKHAYLOV, YU. A., RODE, A. V., SKLIZKOV,
G. V., SURGUTSKOV, R. P., and FEDOTOV, S. I.

[Text] The paper describes a technique for inspecting and selecting optical
elements for multichannel laser installations. The method is based on de-
termination of distortions of the wave front, and gives high accuracy in
measuring the degree of flatness and nonparallelism of the faces of optical
elements, the degree of nonhomogeneity of glass, the taper of prisms, focal
length and length of the caustic of spherical lenses, the energy distribution
over the cross section of the caustic and a number of other parameters.

USSR   UDC   535.33:621.375.8;535:530.182;778.38

THERMAL PUMPING OF PHOTORECOMBINATION LASERS

Kiev KVANTOVAYA ELEKTRONIKA [Quantum Electronics. Collection of Works] in
Russian No 10, "Naukova dumka," 1976 pp 27-42

KOCHELAP, V. A., and KUKIBNYY, YU. A.

[Text] An examination is made of problems of thermal pumping of photorecom-
bination lasers on electronic phototransitions. An examination is made of
the flow of gas atoms that recombine into a diatomic molecule in a supersonic
nozzle. An investigation is made of nonequilibrium dissociation, the criterion
of inverse population and the energy stored in the inverted states. An exami-
nation is made of the way that these quantities depend on initial conditions
and the shape of the nozzle. Also considered is the feasibility of using a
nonadiabatic cooling method and problems of light amplification in the course
of more complicated chemiluminescent recombination reactions $XO + O \pm (M) \rightarrow$
$\rightarrow XO_2 + (M) + h\omega$, X = N, S, C. References 28.

USSR   UDC 535.2

PROPAGATION OF WAVEGUIDE MODES IN A NONLINEAR AMPLIFYING MEDIUM

KUZ'MINA, N. V., and ROZANOV, N. N.

[Abstract] A general investigation is made of one-wave modes of propagation
of plane waveguide modes in optical masers with transverse optical nonhomo-
geneity. It is shown that small perturbations of single-wave modes corres-
pond to both a continuous and discrete spectrum, the latter not generally
coincident with the spectrum of steady-state waveguide modes. The analysis
is based on a parabolic equation for a slowly varying field amplitude. Con-
ditions of stability are found for single-wave modes, and special cases are
considered in regions narrower and wider than the distance between nodes of
the eigen-functions. It is shown that single-wave modes will all be unstable
at high intensities due to excitation of other waveguide modes. References
7: 6 Russian, 1 Western.

USSR   UDC 539.194+621.373:535.06

DETERMINATION OF THE EINSTEIN COEFFICIENTS OF SPONTANEOUS EMISSION OF TF
MOLECULES BY USING A CHEMICAL LASER ON A MIXTURE OF T_2 + NF_3

NIKITIN, A. I., and ORAYEVSKIY, A. N.

[Russian abstract provided by the source]

[Text] The Einstein coefficients are compared for spontaneous emission of
DF and TF molecules on transitions of the 3-2 band. The Einstein coefficients
were determined by using the difference between the delay times of emission
signals on DF and TF molecules with initiation of the chemical reaction in
mixtures of identical composition and in the same optical cavity. The value
$A_2^3(TF)$ = (57 $\pm$ 17) s^{-1} is found for the Einstein coefficient of the 3-2 band
of the TF molecule. References 9: 3 Russian, 6 Western.

UDC 551.508.769

ON THE PROBLEM OF LASER PROBING OF ATMOSPHERIC WATER VAPOR BY A RESONANCE
METHOD

VOYTSEKHOVSKAYA, O. K., MAKUSHKIN, YU. S., MARICHEV, V. N., MITSEL', A. A.,
SAMOKHVALOV, I. V., and SOSNIN, A. V., Institute of Optics of the Atmosphere,
Siberian Department, Academy of Sciences USSR

[Abstract] Quantitative and qualitative studies are done on the average mass
coefficient of absorption of radiation by gases as a basis of remote deter-
mination of water vapor in the atmosphere. Absorption of laser emission on
694.38 nm is estimated with consideration of the difference in the spectral
width of pulses probing the atmosphere. Analysis of calculations of the ab-
sorption coefficients for a homogeneous path near the ground and for a verti-
cal path in the atmosphere shows that the averaging effect of the spectral
contour of the emission has to be considered. Disregarding line width can
lead to errors of over 100% on a path of 1 km. The use of a third probing
frequency can reduce the error of reconstruction of the concentration profile
of an absorbing component due to different models of the atmosphere and the
line contour. Frequency displacement of ruby laser emission in the absorp-
tion line can cause considerable errors in interpretation of laser probing
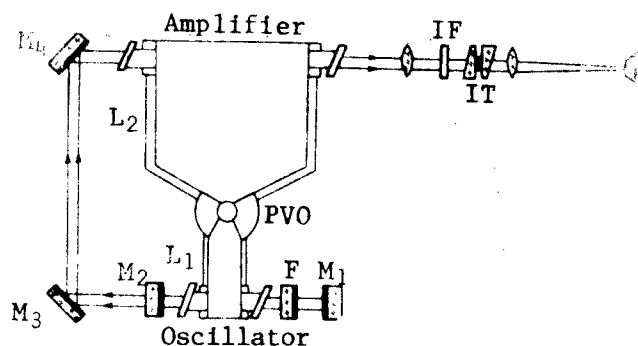data. References 9: 2 Russian, 7 Western.

UDC 535.374:621.375.8

ONE-FREQUENCY MODE OF OPERATION OF A NITROGEN LASER

BRAZOVSKIY, V. YE., LISITSYN, V. N., and RAZHEV, A. M., Institute of Physics
of Semiconductors, Siberian Department, Academy of Sciences USSR, Novosibirsk,
and Novosibirsk State University

[Abstract] A report on experiments done with a pulsed nitrogen laser on a
wavelength of 427.8 nm. The high-pressure gas laser was set up in a "master
oscillator-amplifier" arrangement, as shown in the figure.

The discharge cell of the oscillator 1 x 3 mm in cross section and 40 mm long was located in a selective optical cavity made up of flat mirrors--opaque M_1 and semitransparent M_2 with transmittance of 0.1--and absorbing aluminum film F with transmittance of 0.58. The amplifier cell measuring 5 x 5 x 300 mm and the oscillator cell were filled with a nitrogen-helium mixture at about 6 atmospheres. Both cells were excited by a single pulse voltage oscillator (PVO) through matching strip line sections L_1 and L_2. In addition,the circuit incorporated an optical delay line comprised of mirrors M_3 and M_4 to eliminate the mutual influence of the amplifier and oscillator. Optical coupling was varied by using calibrated attenuators at the amplifier input. The recording system included an IT-28-30 interferometer with base of 16 mm, an FEK-15 coaxial photocell, an I2-7 oscilloscope and a camera. It is shown that external single-frequency emission acting on a gas laser in the super-emittance mode eliminates the typical granular structure and multicomponent emission spectrum observed for this type of operation, resulting in single-frequency operation on the frequency of the driving laser field. The authors thank S. G. Rautian for constructive discussion of the results. Figures 2; references 11 (Russian).

INVESTIGATION OF A COPPER VAPOR PULSE LASER

ISAYEV, A. A., and KAZARYAN, M. A.

[Abstract] An investigation is made of some characteristics of copper vapor lasers operating in the self-heating mode. Gas discharge tubes were used that were made from high-alumina ceramic from 1.5 to 21 mm in diameter with an active length of 16-70 cm. The electrodes were outside of the heating zone. Stimulated emission was observed on 510.5 and 578.2 nm when the temperature of the wall reached about 1500°C. Pulse recurrence rate was up to 20 kHz. For tubes 8 and 15 mm diameter and 70 cm long with pulse recurrence rate of 15 kHz and voltage of 20-23 kV across the working capacitor, the

maximum average power was 6 and 16 W respectively with efficiencies of 0.4% for an 8 mm tube and 1% for a 15 mm tube. Figures 4; references 10: 5 Russian, 5 Western.

A HIGH-POWER PULSED CO_2 LASER WITH UNSTABLE RESONATOR

DATSKEVICH, N. P., KARLOVA, YE. K., KARLOV, N. V., KOVAL'CHUK, B. M., KONEV, YU. B., KONONOV, N. N., KOCHETOV, I. V., KUZ'MIN, G. P., MESYATS, G. A., NIKIFOROV, S. M., PEVGOV, V. G., and PROKHOROV, A. M., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow

[Russian abstract provided by the source]

[Text] A report on a study of a pulsed CO_2 laser with semi-self-maintained discharge. When an unstable optical cavity is used, pulse energy of 7.5 kJ is attained. Calculations are done on the way that energy characteristics depend on the coupling factor of the resonator. It is shown that theoretical calculations agree well with experimental data. Figures 3; references 13: 6 Russian, 7 Western.

INVESTIGATION OF THE MECHANICAL ACTION OF PULSED CO_2 LASER EMISSION ON SOLID TARGETS IN A GAS ATMOSPHERE

AGEYEV, V. P., BARCHUKOV, A. I., BUNKIN, F. V., KONOV, V. I., SILENOK, A. S., and CHAPLIYEV, N. I., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Abstract] The paper gives the results of a systematic study of the mechanical effect that a laser spark of low-threshold breakdown has on solid targets as a function of the geometric parameters of the plasma region, emission intensity in the focal spot, the dimensions and shape of the targets and the pressure and kind of gas that surrounds the target. Optimum conditions are determined for maximizing specific impulse I/E, which is important in developing laser rockets. The pulse receivers were flat, hemispherical and conical targets fastened to a ballistic pendulum. The mechanical impulse resulting

from interaction between the target and the breakdown plasma was determined from horizontal deflection of the pendulum. The experiments were done in air, helium and xenon at pressures of 0.01-1 atmosphere. The results are interpreted on the basis of point explosion theory. The authors thank A. M. Prokhorov for continued interest in the work. Figures 12; references 15: 8 Russian, 7 Western.

USSR   UDC   621.378.33:621.373:535

ON THE SENSITIVITY TO OSCILLATIONS IN DISCHARGE CURRENT OF A HELIUM-NEON LASER OPERATING ON NEON BOUND TRANSITIONS $3s_2-2p_4$ AND $3s_2-3p_4$

BORISOVA, M. S., and YAKOVLEV, A. I.

[Russian abstract provided by the source]

[Text] The sensitivity of emission intensity on a wavelength of 0.63 μm to fluctuations in discharge current is calculated for a helium-neon laser excited by direct current. The authors determine the extent to which this sensitivity is influenced by simultaneous stimulated emission on the bound transition with wavelength of 3.39 μm over a wide range of variation in discharge current and modulation frequency. It is shown that oscillations of the intensity of emission on 0.63 μm caused by oscillations in discharge current can be appreciably reduced not only in the region of low modulation frequencies (0-1 kHz), but also on a certain "resonant" frequency of a few tens of kHz. The theoretical results are confirmed by an experiment in the 0-100 kHz frequency range. The authors thank I. P. Mazan'ko and G. A. Petrashko for continued interest in the work and discussion of the results. Figures 4; references 13: 9 Russian, 4 Western.
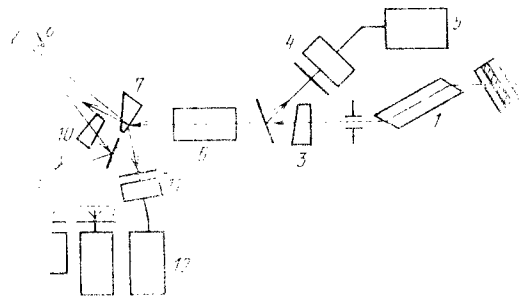
STATISTICAL PRINCIPLES THAT GOVERN SURFACE DESTRUCTION OF OPTICAL GLASS UNDER
THE ACTION OF WIDE LASER BEAMS

BESSARAB, A. V., KORMER, S. B., PAVLOV, D. V., and FUNTIKOV, A. I.

[Russian abstract provided by the source]

[Text] The paper gives the results of measurements of the surface optical
strength of K-8 glass for comparatively large dimensions of a laser spot (from
2 to 120 mm^2). The emission source was a neodymium laser with energy of 200 J
and pulse duration of 10^{-7} s. A reduction in radiation strength is observed
with an increase in spot dimensions. It is shown that the surface strength
is not uniquely determined by the threshold power (energy) density, but rather
is characterized by a fracture probability that depends on emission intensity
and spot size. An increase is observed in the radiation strength of sections
of the surface exposed to a series of light pulses of subthreshold intensity.
The experimental results are explained within the framework of a probabilistic
mechanism of destruction on absorbing inclusions randomly distributed on the
surface of the glass. References 13: 9 Russian, 4 Western.

A SYNCHRONOUS PICOSECOND LASER WITH TUNABLE FREQUENCY

GROZEVA, M. G., PAVLOV, L. Y., STAMENOV, K. V., and KHADZHIYSKI, N. G.,
Sofia University, Bulgaria

[Abstract] Experiments are done on development of a synchronously stimulated
dye laser with a diffraction grating in the cavity. The diagram shows the
experimental setup.

1--neodymium rod; 2,3--opaque and output mirrors of the meodymium laser;
4--FEU-22 photomultiplier; 5--S1-37 oscilloscope; 6--KDP crystal; 7--glass
prism; 8--cell with rhodamine-6 GDN; 9--diffraction grating; 10--output
mirror of the dye laser; 11--FEK-09 coaxial photocell; 12--I2-7 oscilloscope;
13--system for registration of the output emission of the dye laser

The master oscillator was a mode-locked neodymium laser. The mirrors of the
master laser had reflection of 99 and 4%, and the optical cavity was 150 cm
long. A cell with nonlinear absorber 2 mm thick was located close to the
opaque mirror; initial transmission of the cell was 65-70%. The time charac-
teristics of the main laser were measured by an FEK-15 photocell and an I2-7
oscilloscope. The chain of picosecond pulses had a total duration of 200-250
ns, and the space between individual pulses was 10 ns. The average energy of
the pulse train was 63 mJ, and laser divergence was $0.6 \cdot 10^{-3}$ radian. Pulse
duration was determined by measuring correlation functions of second and third
orders. To do this, the neodymium laser emission was split into two beams,
one of them being sent through an optical delay line. The correlation func-
tions were measured after nonlinear interaction of the two beams on the sur-
face of a GaAs crystal. Average pulse duration was 10 ps. A KDP crystal 4 cm
long was used for frequency doubling in an interaction of the $^o1^o1-e_2$ type.
The average energy of the pulse train on 530 nm was 27 mJ. This emission was
used to stimulate the dye laser, the average intensity of each pumping pulse
being about 6 GW/cm^2. Emission was achieved in a solution of rhodamine-6 GDN
in ethyl alcohol. The output of the dye laser was tuned over a range of 550-
602 nm by a TF-17 diffraction grating with 1200 lines per mm. The reflectance
of the output mirror was 65%. The coefficient of conversion of the second
harmonic of the main laser to dye laser emission was 7%. An investigation is
made of the emission spectrum, divergence, and time characteristics of the
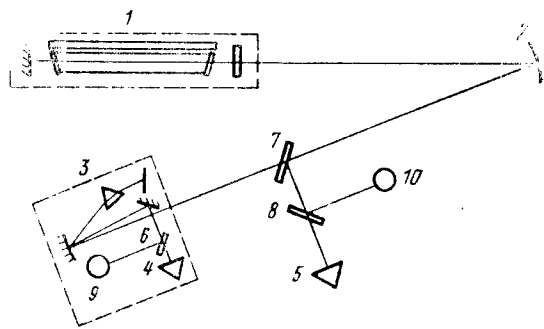dye laser as a function of wavelength. Figures 4; references 3 (Western).

INVESTIGATION OF THE SPECTRAL-TIME CHARACTERISTICS OF EMISSION OF A CHEMICAL
LASER OPERATING ON HF MOLECULES

BORISOV, V. P., VELIKANOV, S. D., KORMER, S. B., SINITSYN, M. V., and FROLOV,
YU. V.

[Abstract] The paper describes a technique for measuring the energy and time
parameters of individual spectral components of emission of a chemical laser.
The energy measurements were made with calorimetric sensors, and the time
characteristics were measured by photoresistors. The experimental setup is
shown in the diagram.

1--laser; 2--spherical mirror; 3--IKM-1 monochromator; 4,5--IMO-2 energy sensors; 6,7,8--CaF_2 plates; 9,10--FSG-22-3A photoresistors

Laser emission was focused by the spherical mirror on the input slit of the monochromator, and the reception part of the calorimetric energy sensor was set up beyond the output slit. A CaF_2 beam splitter sent part of the energy to a photoresistor (Ge-Au). The investigated laser operated on a mixture of $F_2:H_2:O_2:He = 3:1:2:9$ with total pressure of 114 mm Hg. The laser cell was a quartz tube with inside diameter of 24 mm and length of 750 mm. The optical cavity was made up of a gold-plated steel mirror with reflectance of about 0.96 and a plane-parallel CaF_2 plate with reflectance of about 0.06. Pumping was by a xenon flash tube. Emission was achieved in pulses with duration of 4 μs and energy of 2 J. The emission spectrum showed five vibrational-rotational bands of the P-branch of emission of the HF molecule $(\nu \rightarrow \nu - 1 = 1-0,$ 2-1, 3-2, 4-3, 5-4) at wavelengths of 2.7-3.3 μm, comprising 27 spectral lines. The distribution of laser emission by vibrational-rotational bands was experimentally determined: $E_{1-0}:E_{2-1}:E_{3-2}:E_{4-3}:E_{5-4} = 0.53:1:0.42:0.18:0.09.$ The results show that formation of the emission spectrum of a laser based on the reaction $H_2 + F_2$ is influenced both by chemical reactions that populate levels of the HF molecules and by processes of V - T exchange and stimulated emission. Figures 3; table 1; references 11: 5 Russian, 6 Western.

TAILORING A HIGH-POWER SPIKE PULSE IN A LASER AMPLIFIER SYSTEM

KRYZHANOVSKIY, V. I., MAK, A. A., SVENTITSKAYA, I. N., SEREBRYAKOV, V. A., FLEGONTOV, YU. A., and CHERTKOV, A. A.

[Russian abstract provided by the source]

[Text] The authors consider problems in the development of high-power laser systems that include a master oscillator and a number of laser amplifiers in series, giving a tailored pulse at the output. A technique is worked out for calculating the signal at the input of the laser amplifier system that is

required to produce the given tailored pulse at the output. On the basis of this method, an eleven-stage amplifier system is calculated with elements that correct the pulse shape. An original circuit is proposed for a generator that produces pulses of controllable shape and duration, and results of investigation of this circuit are presented. Reference 1 (Russian).

AN ANALYTICAL METHOD OF CALCULATING THE ENERGY PARAMETERS OF THERMAL GASDYNAMIC LASERS

PIMENOV, V. P., and SHCHEGLOV, V. A., Physics Institute imeni P. N. Lebedev, Moscow

[Abstract] Analytical relations are derived for the energy parameters of a thermal gasdynamic laser that operates on a mixture of the N_2-CO_2-M type-- intensity, power and width of the lasing zone. Consideration is taken of the way that the mean number of quanta ν_1 and ν_2 are related in modes of the CO_2 molecule. The method of quasi-steady state emission was utilized in deriving the expressions. This method is valid where a large part of the useful vibrational energy is initially concentrated in the carrier gas, which is the case in practice for thermal gasdynamic lasers. An investigation is made of the influence that the rate of relaxation of the deformation mode of CO_2 has on the laser parameters. It is shown that a reduction in the rate of relaxation of the lower laser level appreciably reduces emission intensity. References 11: 6 Russian, 5 Western.

THREE-MODE STIMULATED EMISSION IN A GAS LASER

TOLCHINSKAYA, T. B., TIUNOV, YE. A., and FRADKIN, E. YE., Leningrad State University imeni A. A. Zhdanov

[Russian abstract provided by the source]

[Text] Experiments are done on stimulated emission of three longitudinal
modes in a helium-neon laser on λ = 0.6328 μm. Regions of stable emission
with different three-mode locking conditions are determined as a function of
pressure and pumping. When the mismatch of emission frequencies relative to
the center of the amplification line varied, narrow regions of desynchroniza-
tion of intermode beats were observed within the mode-locked region with phase
$\phi = \pi$. The minimum width of the region is less than 6 MHz. In these regions,
conditions of nonlinear self-modulation are realized with frequency of inter-
mode beats of 2-10 kHz. To compare the results of experiments and theory, a
numerical calculation is done on regions of existence and stability of sym-
metric and asymmetric three-mode stimulated emission. Figures 4; references
13: 10 Russian, 3 Western.

ON THE THEORY OF HIGH-POWER MOLECULAR AMPLIFIERS ON CO_2

TRUSHIN, S. A., and CHURAKOV, V. V., Institute of Physics, Academy of Sciences
BSSR, Minsk

[Russian abstract provided by the source]

[Text] A comparatively simple analytical technique is developed for calculat-
ing the energy and time characteristics of high-pressure CO_2 amplifiers. An-
alysis of operation of the amplifier is based on singling out a number of limit-
ing conditions; this is possible because of the hierarchy of relaxation pro-
cesses inherent in the molecules of the active medium. The results of the
calculation agree well with experimental data. The authors thank Academician
of the Academy of Sciences BSSR B. I. Stepanov for useful discussion of the
results. Figures 3; references 11: 5 Russian, 6 Western.

INVESTIGATION OF PROCESSES OF DESTRUCTION OF DIELECTRIC FILMS UNDER THE ACTION
OF LASER EMISSION

ZVEREV, G. M., KOLYADIN, S. A., LEVCHUK, YE. A., and SKVORTSOV, L. A.

[Russian abstract provided by the source]

[Text] An investigation is made of processes of destruction of titanium di-
oxide and silicon dioxide dielectric films exposed to lasing action. Some
supplementary experiments were done on films with altered stoichiometric com-
position SiO_x, TiO_x ($x < 2$) as well as on rutile crystals. Fracture thresholds
were studied as a function of emission wavelength, conditions of focusing, and
temperature of the study specimens. A special examination was made of the
influence of surface defects on the resistance of the films to lasing action.
Possible mechanisms of film destruction are discussed on the basis of the ex-
perimental results. Figures 4; references 9: 4 Russian, 5 Western.

A HIGH-PRESSURE RADIATION-CHEMICAL LASER INITIATED BY A BEAM OF FAST ELECTRONS
FROM A HIGH-VOLTAGE COAXIAL DIODE

VOINOV, A. M., DOVBYSH, L. YE., KAZAKEVICH, A. T., MEL'NIKOV, S. P., and
SINYANSKIY, A. A.

[Russian abstract provided by the source]

[Text] The article gives the results of a study of the energy parameters of
a radiation-chemical laser on a mixture of SF_6-H_2 at a pressure of up to 10
atmospheres. The working mixture was initiated by an electron beam shaped
by a coaxial field emission diode. The maximum energy of laser emission
registered for a mixture SF_6:H_2 = 70:1 at a pressure of 2.7 atmospheres was
0.79 J, which corresponds to a specific energy of stimulated emission of
21 $mJ \cdot cm^{-3}$. The efficiency of conversion of electron beam energy to laser
emission energy was about 5%. References 8: 4 Russian, 4 Western.

UDC 621.378.3+621.314.26

OPTICAL PARAMETRIC LIGHT GENERATORS (A SURVEY)

FISCHER, R., Central Institute of Optics and Spectroscopy, Academy of Sciences
of East Germany, Berlin, and KULEVSKIY, L. A., Physics Institute imeni P. N.
Lebedev, Academy of Sciences USSR, Moscow

[Translation from the German by L. A. Kulevskiy; Russian abstract provided by
the source]

[Text] The survey gives the fundamentals of the theory of optical parametric
light generators. The formulas necessary for calculating the basic parameters
of these devices are given in chapters 1-6, experimental results relating to
research and development on parametric light generators of various types and
to applications of these devices are given in chapter 7, methods of extending
the tuning range of parametric light generators are discussed in chapter 8,
and the possibilities for realization of four-photon generators are considered
in chapter 9. Different types of tunable lasers are compared in the conclud-
ing chapter 10. Figures 13; tables 3; references 278: 72 Russian, 206
Western.

MANY-PHOTON PROCESSES IN THE RADIATION FIELD OF A MULTIMODE LASER

ARSLANBEKOV, T. U., Staff of the Institute of Nuclear Physics, Academy of
Sciences Uzbek SSR, DELONYE, N. B., MASALOV, A. V., TODIRASHKU, S. S., Staff
of Kishinev State University and FAYNSHTEYN, A. G., Staff of Voronezh State
University, The Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The authors measured the probability of the many-photon ionization
process with a fixed pulse-average field strength of single-mode and multi-
mode lasers. For a power-law five-photon process the probability in the field
of a multimode laser is 5! times greater. For an eleven-photon process the
authors measured a factor significantly less than 11!. This decrease can be
explained by the deviation from power law in the region that is transitional
toward tunneling. Figures 4; references 17: 14 Russian, 3 Western.

USSR UDC 621.373.826

QUASI-STABLE STATE OF AN AMPLIFYING MEDIUM WITH UNLIMITED ENERGY STORAGE

KRUZHILIN, YU. I., Moscow Institute of Radio Engineering, Electronics and Automation

[Russian abstract provided by the source]

[Text] The author examines the dynamics of population inversion and density of the photon field in an amplifying medium enclosed in a completely reflective cavity with fast inversion switching. A dimensionless parameter D is introduced that characterizes the stability of the medium. It is shown that because of inertness of self-excitation when $D \gg 1$, the initial density of the stored energy is maintained for a finite time determined by the specific amplification factor, and when $D < 1$ the influence of self-excitation can be disregarded. References 3: 1 Russian, 2 Western.

USSR

SELF-FOCUSING OF RUBY LASER EMISSION IN SINGLE CRYSTALS OF SILICON CARBIDE

BORSHCH, A. A., BRODIN, M. S., and VOLKOV, V. I., Institute of Physics, Academy of Sciences Ukrainian SSR

[Abstract] The authors investigated the dynamics of self-focusing of ruby laser emission in single crystals of SiC(6H) and SiC(15R) as well as the dependence of the self-focusing threshold on the concentration of free carriers in the conduction band. They found that the refractive index of silicon carbide varies with increase in laser emission intensity for times no greater than 10^{-9} sec. They demonstrated that the nonlinearity of the refractive index of silicon carbide is caused basically by free electrons at 300 K and nonlinear polarizability of bound electrons at 77 K. Figures 3; references 10: 2 Russian, 8 Western.

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USSR

ROTATIONAL NONEQUILIBRIUM AND ENERGY CHARACTERISTICS OF A CHEMICAL LASER
OPERATING ON THE H_2+F_2 CHAIN REACTION

VASIL'YEV, G. K., GUR'YEV, V. I., and TAL'ROZE, V. L., Branch of the Institute
of Chemical Physics, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The authors conducted an experimental investigation of the influence
of C_5F_{12} molecules on the energy characteristics of a pulsed chemical laser
operating on the H_2+F_2 chain reaction. They demonstrated that the observed
increase in emission energy upon addition of C_5F_{12} is accompanied by a slow-
down in chemical reaction rate. This experimental fact is attributed to an
increase in rate of rotational relaxation of the HF molecules. Figures 4;
references 25: 15 Russian, 10 Western.

USSR

GENERATION OF HARMONIC $3/2\, \omega_0$ OF NEODYMIUM LASER EMISSION IN HEATING OF
SPHERICAL TARGETS

AVROV, A. I., BYCHENKOV, V. YU., KROKHIN, O. N., PUSTOVALOV, V. V., RUPASOV,
A. A., SILIN, V. P., SKLIZKOV, G. V., TIKHONCHUK, V. T., and SHIKANOV, A. S.,
Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The authors measured the spectral composition and intensity of the
harmonics $3/2\, \omega_0$ generated by the heating of microspheres of glass by the
emission of a powerful "Kal'mar" neodymium laser. Using the theory of para-
metric turbulence they interpret the phenomenon and demonstrate the possi-
bility of determining the parameters of laser plasma in the range of one
quarter of the critical density on the basis of spectral measurements of
harmonic $3/2\, \omega_0$. Figures 6; references 21: 17 Russian, 4 Western.

KINETIC THEORY OF RESONANT EMISSION OF A MAGNETIZED PLASMA FROM AN OPEN
PERIODIC WAVEGUIDE

HESTRINA, H. M., KOBELYEV, V. M., and SHESTOPALOV, V. P., associate member of
the Academy of Sciences UkrSSR, Institute of Radiophysics and Electronics,
Academy of Sciences, UkrSSR

[Russian abstract provided by the source]

[Text] It is shown in the framework of a linear theory based on the descrip-
tion of a plasma by a homgeneous kinetic equation that when a narrow-slot
waveguide filled with a magnetized plasma is excited by a modulated electron
flux, anomalously strong leakage of the diffraction field to the outside may
arise when certain restrictions are imposed on the parameters. In this situa-
tion the specific flux of the emitted energy is proportional to the square of
the sine of the emission angle, and is an invariant relative to the thermal
velocity spread of the plasma electrons. It is pointed out that the described
effect can be used for plasma diagnosis. References 3 (Russian).

INVESTIGATION OF A HIGH-CURRENT DISCHARGE IN DENSE PLASMA GENERATORS

BOGOMAZ, A. A., BORODIN, V. S., LEVCHENKO, B. P., and RUTBERG, F. G., All-
Union Scientific Research Institute of Electric Machinery, Leningrad

[Abstract] The paper gives the results of an investigation of a high-current
discharge in dense plasma generators. Hydrogen, helium, nitrogen, argon and
lithium hydride vapors are used as the working gases. The initial hydrogen
density is varied over a range of $(1-40) \cdot 10^{-4}$ g/cm^3, currents 30-300 kA, di/dt
$\approx 10^7$-10^9 A/s, discharge duration 0.5-70 ms. It is established that the dis-
charge in hydrogen is turbulent and fills practically the entire discharge
space. The mechanism of energy transfer from the arc to the gas in the dis-
charge space is discussed. The authors examine the energy balance in hydro-
gen arcs burning in the turbulent mode. In a turbulent discharge at a tempera-
ture of the order of 10^4 K the electron concentration is supported chiefly by
the initiating discharge of the wire. Energies calculated with respect to
balance and enthalpy agree fairly well, which shows that most of the energy

stored in the discharge is transmitted to the gas. References 14: 8 Russian, 6 Western.

STATIONARY WAVES IN A BOUNDED PLASMA

RUTKEVICH, B. N., PASHCHENKO, A. V., FEDORCHENKO, V. D., and MAZALOV, YU. P., Physico-Technical Institute, Academy of Sciences UkrSSR, Khar'kov

[Russian abstract provided by the source]

[Text] The authors consider stationary space-charge waves in thin plasma layers and columns, and also in thin electron beams located in a strong longitudinal magnetic field. The analysis is based on a previously developed model of a thin plasma layer for a cold plasma. The equations of motion of electrons under the conditions of applicability of the given model have steady-state solutions that correspond to waves of two types that differ with respect to propagation velocity and a number of other characteristics. Corresponding to these solutions are two branches of the dispersion curve for low-amplitude waves. In the case of waves of finite amplitude, a nonlinear solution is found that defines the wave profile and propagation velocity as dependent on amplitude. The maximum values of the potential and strength of the magnetic field are found on the basis of exact equations for space-charge solitons. References 10: 9 Russian, 1 Western.

HEATING OF IONS WHEN A HIGH-CURRENT ELECTRON BEAM INTERACTS WITH A PLASMA AND PART OF THE BEAM IS CAPTURED IN A MAGNETIC-MIRROR TRAP

KOLYADA, YU. YE., KORNILOV, YE. A., FAYNBERG, YA. B., and KIYASHKO, V. A.

[Abstract] An experimental study is done on ion heating when a high-current electron beam with transverse velocity component having a duration of up to 1 μs interacts with a plasma in a magnetic field of mirror configuration, a part of the beam being captured by the magnetic trap. It was found that passage of the beam through the plasma stimulated high-frequency oscillations,

and also a wide spectrum of low-frequency oscillations in the lower hybrid resonance region near the ion plasma frequency, leading to heating of the plasma ions. The temperature reaches 200 eV at a density of $5 \cdot 10^{12}$ cm^{-3}. The excitation of low-frequency oscillations is apparently due to the development of parametric instabilities. The particles trapped in the magnetic mirror configuration produce a space charge. The captured beam particles are localized on the peripheral region of the plasma and form a hollow cylinder with inside radius of ≈ 3 cm, outside radius of ≈ 4 cm and length of ≈ 20 cm within which the plasma is contained. The theoretical value of the electric field in the layer (averaged with respect to thickness) reaches 100 kV/cm. With formation of a cloud, the plasma ions located in the field are accelerated in the radial direction and enter the plasma surrounded by the electron layer. As a result, the plasma ion distribution function shows an accelerated group of particles in the 3-4 keV energy region. The presence of an accelerated group of ions in the plasma leads to the development of a double-peak instability and stimulation of oscillations lying in the vicinity of the lower hybrid resonance; the energy content of the high-energy ions decreases, and the temperature of the main (low-temperature) group of particles increases, reaching 500 eV. Thus the space charge that develops in the plasma promotes further heating and containment of the ion component, which can be used in controlled thermonuclear fusion. References 19: 16 Russian, 3 Western.

CONCERNING ABSORPTION OF A PULSE OF ELECTROMAGNETIC RADIATION IN A PLASMA

PLIS, A. I., and SHCHEGLOV, V. A., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, Moscow Power Engineering Institute

[Abstract] The authors consider the problem of radiation transport with propagation of monochromatic electromagnetic radiation in a plasma. An analytical solution is found that describes signal propagation when emission is absorbed due to electron collisions with ions and with neutral particles (atoms or molecules). Pulse profiles for different penetrations into the plasma are given as well as the electron temperature profiles at different times. The analysis is limited to plasma for which $\nu_e \tau \gg 1$, where ν_e is the frequency of electron collisions, and τ is the characteristic time of change of energy of the electrons in the plasma. For more rarefied plasmas where $\nu_e \tau$ is of the order of one or less, one must resort to the methods of kinetic theory to describe the interaction between the electrons and the field. References 9 (Russian).

MEASUREMENT OF A LONGITUDINAL CURRENT FIELD BY AN OPEN MICROWAVE RESONATOR
WHEN THE PLASMA DENSITY PROFILE IS IMPRECISELY KNOWN

MOSKALEV, I. N.

[Russian abstract provided by the source]

[Text] In measurement of the magnetic field $B_\phi(r)$ of longitudinal plasma cur-
rent by means of an open barrel-shaped resonator, the frequency shift $(\Delta\omega/\omega)_{i\phi}$
that depends on B_ϕ acts as a correction to the displacement determined by
plasma density and its distribution $n(r)$. Since the function $n(r)$ is also
experimentally determined, and consequently is known with some approximation,
errors in determining the plasma density are compared with the quantity
$(\Delta\omega/\omega)_{i\phi}$; in this case, it becomes impossible to find B_ϕ. The author dis-
cusses conditions of measurement that minimize the influence of inexact
knowledge of the behavior of $n(r)$. It is suggested that frequency shifts in
the barrel-shaped resonator be measured simultaneously on modes with sharply
different frequencies but identical internal caustics. References 6 (Russian).

RADIATION PRESSURE ON THE SURFACE OF A BEAM OF COHERENTLY EMITTING ELECTRONS

KRASOVITSKIY, V. B.

[Abstract] In a previous article [V. B. Krasovitskiy, Zhurnal Eksperimental'-
noy i Teoreticheskoy Fiziki, Vol 64, 1973 p 1597] the author showed that the
radial divergence of an electron beam in a plasma that is caused by insta-
bility can be reduced by placing the plasma-beam system in a decelerating
medium with fairly high permittivity. The resultant emission energy flux
through the lateral surface of the beam carries away part of the power that
is released in the volume of the plasma, and reduces the increment. As a
result, a quasi-steady state may arise in which fluctuation perturbations of
the field are stabilized by the emission, and instability actually does not
develop. In this paper the author investigates the case where instability
does occur, and the energy is accumulated in the volume of the beam and the
plasma. At the same time, part of the power released by the beam escapes
through the boundary, and the electrons of the beam surface are acted on by
a force that is quadratic with respect to the amplitude of the field--a force
of deceleration by radiation that is proportional to beam density since the

radiation is coherent. Since the field amplitude increases exponentially with time, this process is appreciably unsteady. An expression is derived for the radiation force that acts on the surface of a straight beam of arbitrary cross section propagating in a plasma waveguide with dielectric walls. A detailed investigation is made of the conditions of onset of this effect, and the feasibility of using the effect for focusing relativistic beams in plasma is discussed. References 6 (Russian).

USSR

ANOMALOUS LINEAR ABSORPTION OF AN ELECTROMAGNETIC WAVE IN A NONHOMOGENEOUS ISOTROPIC PLASMA

BRODSKIY, YU. YA., GOL'TSMAN, V. L., and NECHUYEV, S. I.

[Abstract] In the absence of collisions, linear absorption of an electromagnetic wave of TM type incident on a nonhomogeneous plasma layer is determined by transformation to damped plasma waves in the region of plasma resonance. Calculations previously done for layers that are smooth on the scale of a wavelength, and also for linear layers suggested a limiting value of 0.5 for the coefficient of absorption with any concentration profiles. In this paper the authors give experimental results that show that the coefficient of absorption may approach unity with proper matching between the incident wave and the plasma layer. A reexamination of the theoretical analysis of linear wave absorption shows that the assumed limiting value of 0.5 is typical only for linear layers. References 5 (Russian).

USSR

PROPERTIES OF NONLINEAR WAVES THAT ARE EXCITED WHEN ELECTRON BUNCHES ARE INJECTED INTO A PLASMA

GLADKIY, A. M., KOVALENKO, V. P., and YUSHMANOV, P. N., Institute of Physics, Academy of Sciences UkrSSR

[Abstract] A theoretical analysis is made of plasma waves stimulated by an electron beam. It is shown that the path traveled by a wave without appreciable change in amplitude can be extended if the beam is injected into the plasma in the form of preshaped electron bunches. The calculations are based on the equation of the potential electric field of linear one-dimensional oscillations of a cold plasma that are excited by a beam with given current density. Experiments were done with electron beam energy of a few eV and average current of 1-10 mA. The beam was shaped by a flat triode system (cathode, control grid, anode). A fixed bias voltage and alternating SHF signal were applied simultaneously to the control gird. The modulated beam was passed through argon at low pressure, producing a plasma with concentration of 10^9-10^{10} cm^{-3}. The experimental results confirmed the theoretical prediction of extended travel of plasma waves excited by preshaped electron bunches. The experiments also confirmed the prediction of transverse equilibrium of electron bunches when the wave frequency is of the order of the plasma frequency or less. In contrast to plasmoids that are formed by beam-plasma instability, preshaped electron bunches can remain in equilibrium in the wave field for a considerable time. However, beginning at a certain distance, the wave damps out fairly rapidly, which is apparently a consequence of specific instability of the system. References 7: 5 Russian, 2 Western.

USSR

MODULATION INSTABILITY OF LANGMUIR WAVES EXCITED IN A PLASMA BY AN ELECTRON BEAM

ANTIPOV, S. V., NEZLIN, M. V., SNEZHKIN, YE. N., and TRUBNIKOV, A. S., Institute of Atomic Energy imeni M. V. Kurchatov

[Abstract] A brief report on research being conducted on the development and behavior of Langmuir solitons in a plasma. An electron beam was used for pumping rather than an external rf field. The stimulating beam is energized throughout the lifetime of the plasma. Plasma density is $3 \cdot 10^9$ cm^{-3} (Langmuir frequency 500 MHz), electron temperature is about 10 eV, diameter of the

plasma column is 3-4 cm, longitudinal magnetic field strength $1.6 \cdot 10^5$ A/m, working gas hydrogen and gas pressure about $3 \cdot 10^{-6}$ mm Hg. It was found that when the current strength of the stimulating beam exceeds a certain threshold (about 3 mA when the electron beam energy is about 100 eV) the Langmuir oscillations excited in the plasma take on the nature of very powerful rarefied pulses (plasmoids) on a frequency of 500 MHz. At the same time, spatial modulation of the plasma density is observed: density "cavities" show up in the region of localization of the plasmoids, where the electron concentration drops to 5-10% of that of the ambient plasma. These structures were found to be approximately stationary with respect to the plasma, and to have a lifetime of at least $2 \cdot 10^4$ periods of the electron plasma oscillations. They are identified as Langmuir solitons, those of greater amplitude being narrower in width. References 6: 3 Russian, 3 Western.

VINOGRADOVA, A. K., and MOROZOV, A. I.

[Abstract] In the two-liquid approximation of plasma flow in a magnetoplasma compressor the authors construct a "pinch" scheme for the B-mode. In contrast to their previous analysis of the A-mode, it is assumed that the plasma flow contains one kind of ion. The distribution of potential and electric currents in the calculations is compared with experiment. References 4 (Russian).

CONCERNING THE QUESTION OF THE STRUCTURE OF THE COMPRESSION REGION IN A MAGNETO-PLASMA COMPRESSOR

KOVROV, P. YE., and MOROZOV, A. I., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] The region of high-concentration plasma at the input of a magneto-plasma compressor is called the compression region. In this paper an experimental investigation is made of the structure of this region. It was shown that small-scale structures arise in the compression region despite "macroscopic" flow stability. The characteristic lifetime of small-scale structures for the main part of the discharge is 10^{-7}-10^{-6} s, and for elapsed times between 20 and 30 μs these structures exist for less than 10^{-7} s. Filamentary formations 1-5 mm in width with a bright glow are observed that have a density appreciably greater than that of the main part of the flow. References 7: 6 Russian, 1 Western.

PLASMA-BEAM DISCHARGE IN METAL VAPORS

SAYENKO, V. A., and VLADIMIROV, A. I., Institute of Nuclear Research, Academy of Sciences UkrSSR, Kiev

[Russian abstract provided by the source]

[Text] An investigation is made of the conditions of ignition of a plasma-beam discharge when the working substance is vaporized by the same electron beam. The working substance was loaded into the electron collector, or was fed as a rod into the ionization chamber perpendicular to the electron beam oscillating lengthwise of the magnetic field. Conditions of stable burning of the discharge are established and the rates of feed of working substances are determined. Ion beams of Cd, Zn, C, Mo and W with a current of 0.4-5 mA are extracted from the discharge crosswise of the magnetic field. [The main results of this research were reported to the Fourth All-Union Conference on Low-Temperature Plasma Physics, Kiev, 1975]. References 12: 11 Russian, 1 Western.

ELECTROMAGNETIC WAVE EMISSION BY A NONRELATIVISTIC ELECTRON BEAM IN A NON-
HOMOGENEOUS ISOTROPIC PLASMA WAVEGUIDE

ROGASHKOVA, A. I., Institute of Radio Engineering and Electronics, Academy of
Sciences USSR, Moscow

[Abstract] The problem of wave transformation in a plasma-beam system is
considered. It is assumed that a cylindrical metal waveguide of given radius
is filled with a cold isotropic plasma. The plasma concentration is taken as
independent of the transverse coordinate, and varies linearly along the axis
of the waveguide. A velocity-modulated electron beam of given radius is con-
tinuously injected into the waveguide in the plane of the axis. It is shown
that this type of excitation can lead to emission of fast electromagnetic
waves. In the case of a homogeneous plasma, these waves propagate with phase
velocities of the order of the velocity of light or greater, and do not inter-
act with the beam. However, if the plasma is nonhomogeneous, emission arises
in the plasma resonance region that passes through a band of opacity and en-
ters the region of wave propagation. The radiation efficiency depends on the
direction of motion of the beam relative to the concentration gradient. An-
alysis shows that the waves have low energy due to the low amplitude of the
current in the plasma resonance region, which is due in turn to the influence
of the space charge field in the plasma. References 12: 11 Russian, 1
Western.

MODES OF OPERATION OF A MAGNETOPLASMA COMPRESSOR. I

VINOGRADOVA, A. K., and MOROZOV, A. I.

[Abstract] A magnetoplasma compressor is a system for accelerating and com-
pressing a plasma flow in its own azimuthal magnetic field. Results of ex-
perimental studies have shown three flow regimes, two of which (called the
A- and B-modes) differ from the third in the absence of any pronounced poten-
tial jump in the cathode region. The third regime (the α-mode) was discovered
earlier and is now in the research stage. This paper describes the results
of an experimental study of electric and magnetic fields in the interelectrode
gap of a magnetoplasma compressor. The authors consider the dynamics of a
plasma flow containing two kinds of ions, assuming that the flux varies slow-
ly and there is no dissipation. Curves are given showing the regions of ex-
istence of the A- and B-modes in voltage-vs-pressure coordinates, and the

A-mode is analyzed in the two-liquid model. The results of experimental research are compared with the theoretical analysis of a two-ion flow, and the possibility of current transfer by impurity ions is discussed. References 6: 5 Russian, 1 Western.

POLARIZATION LOSSES OF A RELATIVISTIC CHARGED PARTICLE IN A PLASMA LOCATED IN A STRONG RF ELECTRIC FIELD

AMATUNI, A. TS., MAGOMEDOV, M. R., SEKHPOSYAN, E. V., and ELBAKYAN, S. S.

[Text] An examination is made of polarization losses of a fast charged particle that passes through a plasma located in a homogeneous rf electric field. It is shown that because of the dispersion properties of the plasma in an external field, terms appear in the polarization losses that depend on the energy of the particle, and the high-frequency plateau for polarization losses occurs at higher energies.

PLASMA INSTABILITY IN THE FIELD OF A STRONG CIRCULARLY POLARIZED ELECTRO-MAGNETIC WAVE

KALMYKOV, A. M., and KOTSARENKO, N. YA., Kiev State University imeni T. G. Shevchenko

[Abstract] The authors study parametric instability of a cold electron plasma in the field of a strong circularly polarized electromagnetic wave with consideration of the relativistic nature of electron motion. An exact dispersion equation is derived and analyzed for small oscillations that develop against the background of the pumping wave. The nature of the instabilities that

arise is determined. It is shown that longitudinal wave instability occurs on frequencies $\omega' \ll \omega_p/k$ and $\omega' \approx \omega_p/k$, while transverse wave instability takes place on frequencies $\omega_0 \pm \omega' \approx \omega_0$ and $\omega_0 \pm \omega_p/k$, where $\omega_p = \sqrt{4\pi e^2 n_0/m}$, n_0 is the density of the compensating ions, $k = (1 - \frac{u_0^2}{c^2})^{-1/2}$. The results of numerical calculation of the dispersion equation for large pumping wave amplitudes, where the approximation of weak coupling between waves is inapplicable, show that with an increase in pumping wave amplitude there is an increase in the increments and expansion of the regions of instabilities. It is found that in the case of excitation of nonpotential plasma oscillations the relativistic nature of electron motion may be decisive for the given effect even for small pumping wave amplitudes. References 9: 8 Russian, 1 Western.

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CONCERNING DECAY INTERACTION OF ELECTROMAGNETIC WAVES IN A SEMIBOUNDED PLASMA

ZABORONKOVA, T. M., KONDRAT'YEV,I. G., and PETROV, V. V., Scientific Research Radiophysics Institute

[Russian abstract provided by the source]

[Text] An examination is made of the linear stage of the parametric instability that arises in high-frequency surface waves guided by a plasma boundary when an intense electromagnetic wave is incident on the plasma from a vacuum. It is shown that instability takes place only for an incident wave of TM type. The instability increment and the threshold amplitude of the incident wave are determined. The influence of weak diffusion of the plasma boundary is discussed. As a special case, results are found for an analogous problem but with a homogeneous electric pumping field. References 6 Russian.

ON PERTURBATION OF A COLLISIONAL PLASMA BY OPPOSED ELECTROMAGNETIC WAVES

VILENSKIY, I. M., and FREYMAN, M. YE., Institute of Geology and Geophysics, Siberian Department, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] An investigation is made of the influence that transfer processes have on resonant interaction of counter propagating electromagnetic waves. It is shown that under the conditions of the ionosphere the resultant quasi-periodic perturbations of charged particle concentration may strongly reflect radio waves. References 4 (Russian).

DECAY OF NONHOMOGENEITIES OF PLASMA FORMATIONS OF THE IONOSPHERE IN THE GEOMAGNETIC FIELD

FILIPP, N. D.

[Russian abstract provided by the source]

[Text] An investigation is made of the influence of a magnetic field on the process of ambipolar diffusion of nonhomogeneities of plasma formations. It is found that in the E layer of the ionosphere at an altitude of more than 95 km the period of decay of nonhomogeneities direct along the earth's magnetic field is considerably greater than in the absence of a magnetic field as a consequence of the fact that ambipolar diffusion in this case is "controlled" by electron diffusion. Experiments done in middle latitudes on a 1330 km transmission path at a frequency of 74 MHz confirmed the theoretical conclusion that the average duration and mean hourly number of reflected radio signals from magnetically oriented nonhomogeneities of meteoric origin are considerably greater than the corresponding parameters of radio reflections from ordinary sporadic meteor trails. References 20: 9 Russian, 11 Western.

ON SPLITTING AND SHIFTING OF ATOMIC LEVELS BY THE FIELD OF A PLASMA WAVE

KLEYMAN, YE. B., and OYRINGEL', I. M.

[Text] The influence of the field of a plasma wave on the state of an atomic electron is studied in application to a turbulent plasma medium. A general expression is derived for displacement and splitting of the second level of a hydrogen-like atom by the field of a Langmuir wave. It is shown that the displacement of the 2s level of the atom may be comparable with the Lamb shift when the energy density of the Langmuir waves is $W^L \sim 10^7$ erg/cm^3. It is noted that such energy densities are apparently rarely realized in cosmic plasma; for this reason when considering processes of radiation of atoms in a turbulent plasma, the influence of the field of plasma waves on the energy spectrum of electrons in atoms may be disregarded under astrophysical conditions.

DYNAMIC CHARACTERISTICS OF ELECTROHYDRODYNAMIC CONVERTERS WITH JET TURBULIZATION BY EHD ACTION

NAGORNYY, V. S.

[Text] The transient responses of electrohydrodynamic transducers with turbulization of the free submerged jet by a transverse unipolar flux of ions are considered from the standpoint of analyzing processes accompanying unsteady corona discharge in the linear theory of hydrodynamic stability. It is shown that the times of triggering and release of these transducers are made up of the pure delay time and the switching time. References 9: 8 Russian, 1 Western.

ON INVARIANCE OF ELECTROMAGNETIC FLOWRATE TRANSDUCERS TO THE VELOCITY PROFILE
OF THE FLUID

FIKS, I. G.

[Russian abstract provided by the source]

[Text] The paper gives the results of investigation of electromagnetic flow-
rate transducers with nonhomogeneous magnetic field for the case of arbitrary
velocity distribution in the measurement channel. An analytical study is
done on the influence that the distribution of the magnetic field and axially
asymmetric flows of liquid have on the sensitivity and conversion error of
actual transducers. It is shown that corresponding to each fluid velocity
flow profile is a certain distribution of the magnetic field in the measure-
ment channel, where the error of the transducer is equal to zero, which en-
ables the development of electromagnetic transducers for measuring the flow-
rate of axially asymmetric flows with velocity distributions that are stable
in time. References 14: 6 Russian, 8 Western.

FORMATION OF A BACK WAVE BY A STRONG IONIZING SHOCK FRONT IN A MAGNETIC FIELD

ZAKAYDAKOV, V. V., and SYNAKH, V. S.

[Abstract] Propagation of a strong ionizing MHD shock wave in a transverse
magnetic field is considered. The magnetic field is displaced into the re-
gion in advance of the wave front. If propagation is inward between closed
current-carrying conductors, the magnetic field strength in the region pre-
ceding the wave front will increase in proportion to $1/(L - X)$, where L is
the length of the conductors, and X is the coordinate of the shock wave front.
It is assumed that a one-dimensional ionizing MHD shock wave propagates in
the positive direction of the x coordinate. The magnetic field $\vec{H}$ is perpen-
dicular to the motion of the shock wave front. A one-fluid plasma model with
variable degree of ionization is used for the numerical calculation. Heat
conduction and viscosity are disregarded. The principal equations of plasma
flow behind the wave front take the form

$$\frac{\partial \rho}{\partial t}+\frac{\partial}{\partial x}(\rho v)=0; \quad \frac{\partial}{\partial t}(\rho v)+\frac{\partial}{\partial x}\left(p+\frac{H^2}{8\pi}+\rho v^2\right)=0; \qquad (1)$$

$$\frac{\partial \varepsilon}{\partial t}+p\frac{\partial v}{\partial x}+\frac{\partial}{\partial x}(\varepsilon v)=\frac{v}{4\pi}\left(\frac{\partial H}{\partial x}\right)^2; \quad \frac{\partial H}{\partial t}+\frac{\partial}{\partial x}(Hv)=\frac{\partial}{\partial x}\left(v\frac{\partial H}{\partial x}\right)$$

and the equation of state is

$$\varepsilon=\frac{RT}{\gamma-1}+\frac{\alpha I}{k}; \quad T=\frac{p}{R\rho(1+\alpha)}, \qquad (2)$$

where ρ is density, v is plasma velocity, p is pressure, ε is internal energy, $v = c2/4\pi\sigma$ is the magnetic viscosity of the plasma, α is the degree of ionization, and I is the ionization potential. Curves are plotted for the temperature profiles, energy dissipation as a function of coordinate and velocity profiles behind the ionizing wave. The results show that a new shock wave arises, propagating in the direction opposite to the main wave. The behavior of this wave is not analyzed, as it requires a new model with a complete kinetic equation of ionization. References 7 (Russian).

CALCULATION OF PLASMA ACCELERATION IN A COAXIAL CHANNEL

BELIKOV, A. G., GONCHARENKO, V. P., GONCHARENKO, D. K., and DEREPOVSKIY, N. T.

[Abstract] The paper presents a nonstationary two-dimensional MHD-model of a pulsed coaxial plasma accelerator. The magnetohydrodynamics equations are solved simultaneously with the equations of the external electric circuit. The proposed model is used as a basis for calculating plasma acceleration in a coaxial channel of fixed cross section. The system of equations used in the calculations takes the form

$$\frac{\partial \rho}{\partial t} + \frac{1}{r}\frac{\partial}{\partial r}(r\rho v_z) + \frac{\partial}{\partial z}(\rho v_z) = 0; \tag{1}$$

$$\rho\left(\frac{\partial v_r}{\partial t} + v_r\frac{\partial v_r}{\partial r} + v_z\frac{\partial v_r}{\partial z}\right) + \beta\frac{\partial \rho}{\partial r} + \frac{1}{r}\frac{\partial}{\partial r}(rH_\varphi)H_\varphi = 0; \tag{2}$$

$$\rho\left(\frac{\partial v_z}{\partial t} + v_r\frac{\partial v_z}{\partial r} + v_z\frac{\partial v_z}{\partial z}\right) + \beta\frac{\partial \rho}{\partial z} + H_\varphi\frac{\partial H_\varphi}{\partial z} = 0; \tag{3}$$

$$\frac{\partial H_\varphi}{\partial t} - \eta\left\{\frac{\partial}{\partial r}\left[\frac{1}{r}(rH_\varphi)\right] + \frac{\partial^2 H_\varphi}{\partial z^2}\right\} + \frac{\partial}{\partial r}(v_r H_\varphi) + \frac{\partial}{\partial z}(v_z H_\varphi) -$$

$$-\xi\left\{\frac{\partial}{\partial z}\left[\frac{H_\varphi}{r\rho}\frac{\partial}{\partial r}(rH_\varphi)\right] - \frac{\partial}{\partial z}\left(\frac{H_\varphi}{\rho}\frac{\partial H_\varphi}{\partial z}\right)\right\} = 0; \tag{4}$$

$$p = \rho; \tag{5}$$

$$E_r = \eta j_r + v_z H_\varphi - \xi\frac{j_z}{\rho}H_\varphi; \qquad E_z = \eta j_z - v_r H_\varphi - \xi\frac{j_r}{\rho}H_\varphi; \tag{6}, \tag{7}$$

$$\rho = \frac{1}{1 + s^2 z^2}; \qquad I = -\alpha_1\frac{dU}{dt}; \tag{8}, \tag{9}$$

$$U = \alpha_1\frac{dI}{dt} + \alpha_2 I + \frac{\alpha_3}{\eta}U_n, \tag{10}$$

where ρ is plasma density, v is plasma velocity, H is magnetic field strength, p is plasma pressure, E is electric field strength, I is total discharge current, U is the voltage across the capacitor bank, and U_n is the voltage across the plasma. The subscripts r and z denote the projections of vectors on the r and z axes. The proposed model gives a satisfactory qualitative description of such generally accepted facts as the formation of a current layer in the working gap of the accelerator, development of a current loop and transfer of the energy stored in the discharge to the kinetic energy of the plasma flux on the descending branch of the total discharge current. The numerical calculation done in this study gives the mechanism responsible for formation of the current loop. Because of more rapid removal of the plasma mass in the region of space adjacent to the central electrode of the accelerator, a plasma pressure gradient arises that leads to the development of plasma flow away from the outer electrode toward the central electrode. It is this plasma flow that causes current to flow in the direction opposite to the total discharge current, producing the current loop. The results of quantitative comparison of the numerical calculation with experimental data will be given in another paper. References 8: 7 Russian, 1 Western.

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CONCERNING THE STABILITY OF THE INTERFACE BETWEEN TWO DIELECTRIC LIQUIDS IN
AN ELECTRIC FIELD

YERMAKOV, V. I.

[Abstract] The author considers the stability of a flat horizontal interface
between two immiscible liquids located between infinite horizontal electrode
plates with a given potential difference between them. It is assumed that
the liquids are inviscid and incompressible. Their densities, conductivities
and permittivities are known and constant. Fluid flow is potential. It is
shown that in the general case the stability and the nature of small oscilla-
tions of the interface depend appreciably on the potential difference applied
to the electrodes. The special cases of DC and AC voltage across the elec-
trodes are considered. References 8: 6 Russian, 2 Western.

EFFECT OF A MAGNETIC FIELD ON THE SHAPE OF A CAVITATION BUBBLE IN A MAGNE-
TIZABLE FLUID

POPOVA, L. N., and TARAPOV, I. YE.

[Russian abstract provided by the source]

[Text] The authors consider the change in shape of a bubble that is spherical
at time zero in an incompressible, inviscid, nonconductive magnetizable liquid
when it is acted on by pressure and a magnetic field homogeneous at infinity
applied at time zero. Calculations show that the bubble is broken into two
new ones when it collapses in a strong magnetic field. References 3: 2 Rus-
sian, 1 Western.

ON THE THEORY OF THE ANOMALOUS SKIN EFFECT IN A PLASMA WITH DIFFUSE BOUNDARY
IN AN OBLIQUE MAGNETIC FIELD

VASIL'YEV, A. N., Moscow State University, Department of Quantum Theory

[Abstract] The author considers absorption of electromagnetic waves in a
plasma with diffuse boundary located in a magnetic field directed at an ar-
bitrary angle to the surface of the plasma, and derives a system of function-
al equations for the Laplace transforms of the electromagnetic field in the
case where the particle concentration outside the plasma falls off exponen-
tially. An investigation is made of the relation between the resultant system
and the equations for the Fourier field components in a homogeneous plasma.
The y and z axes are directed so that the magnetic field lies in the xy plane
and makes an angle θ with the y axis. The limiting cases of $\theta = 2\pi$ and $\theta = 0$
are considered, and possibilities of solution in the general case are dis-
cussed. The limits of applicability of the system in the case of the anoma-
lous skin effect are determined only by the behavior of particle concentra-
tion outside the plasma. The equqtions are valid if the incident wave damps
out before reaching the region where concentration begins to deviate from the
exponential law. The limits of applicability may vary considerably depending
on how closely the frequency approaches the electron and ion cyclotron fre-
quencies: the closer to the resonant frequency, the less will be the depth
of penetration of the incident wave into the plasma, and the wider will be
the range of applicability of the functional equations. These equations are
also applicable to the problem of natural surface waves in a nonhomogeneous
plasma. The author thanks Academician Ye. M. Lifshits and B. E. Meyerovich
for discussing the results of the work. References 9 (Russian).

INTERACTION OF FLAT ELECTROHYDRODYNAMIC JETS

GRABOVSKIY, V. I., Moscow

[Abstract] A theoretical investigation is made of the interaction of two
unipolarly (like or unlike) charged jets. The charged particles of the dif-
ferent jets may be of one kind or of different kinds. It is shown that the
mutual influence of "short" jets shows up chiefly in a change of their geo-
metric shapes. Electrohydrodynamic jets with identical particles do not in-
tersect anywhere; where the particles are different, there is a mixing zone

that reaches a maximum in the case of oppositely charged particles. The author thanks A. B. Vatazhin for interest in the work. Figures 5; references 9 (Russian).

OPTIMIZATION OF A DC PLASMOTRON WITH A LONGITUDINALLY BLOWN ARC

GONOPOL'SKIY, A. M., and SLOBODKINA, F. A., Moscow

[Abstract] The authors consider the problem of development of electric-arc heaters (plasmotrons) that operate on direct current with a longitudinally blown arc of fixed length. A solution is found for the variational problem of steady-state flow of an electrically conductive gas in an axisymmetric channel of variable cross section. It is assumed that the DC arc is struck along the axis of the channel in the same direction as the gas flow. The part of the flow that is unaffected by the electrode regions of the arc is considered. The induced magnetic field is disregarded. It is assumed that all flow parameters are uniformly distributed in the cross section, and that they vary only lengthwise of the channel. On the basis of the solution, the channel profile is constructed and other controlling parameters are chosen so as to optimize some integral characteristic of the plasmotron. The integral quantity that characterizes the effectiveness of the device might be power, arc length, losses, gas temperature at the outlet and so forth, depending on the use to which the plasmotron is to be put. In comparing the calculations with experimental data, the best agreement was observed for long sectionalized interelectrode inserts where the electric field and current density are close to uniform in each cross section of the channel. The authors thank those who took part in seminars under the direction of G. A. Lyubimov and L. S. Polak for discussion of the work and useful comments. Figures 5; references 8 (Russian).

USSR

INTERACTION OF CHARGED PARTICLES WITH STRONG MONOCHROMATIC RADIATION IN A
HETEROGENEOUS MEDIUM

ARUTYUNYAN, V. M., and OGANESYAN, S. G., Yerevan State University

[Russian abstract provided by the source]

[Text] The authors examine many-photon processes of induced absorption and
emission of a charged particle into an external electromagnetic field inci-
dent on the interface of two media. The effect can be observed in the broaden-
ing of the energy spectrum of a beam of particles. The authors also demon-
strated that the induced processes lead to a modulation of the beam at the
frequency of the external field. References 6: 5 Russian, 1 Western.

USSR

ON THE THEORY OF ELECTROACOUSTIC WAVES IN PLASMA

TSINTSADZE, N. L., and TSKHAKAYA, D. D., Institute of Physics, Academy of
Sciences Georgian SSR

[Russian abstract provided by the source]

[Text] The authors investigate the character of electroacoustic waves in plas-
ma with a negative dielectric constant for strong high-frequency fields in
which the plasma electrons can acquire relativistic velocities. They demon-
strate that under conditions when the pressure of the high-frequency wave is
greater than the hydrodynamic pressure, the electroacoustic wave is a com-
pression wave whereas for weak high-frequency fields they find a rarefaction
wave. References 7: 5 Russian, 2 Western.

USSR

MAGNETIC HYDRODYNAMICS OF A COLLISIONLESS PLASMA

ZHDANOV, S. K., and TRUBNIKOV, B. A., Institute of Atomic Energy imeni I. V.
Kurchatov

[Abstract] By expanding the collisionless kinetic equation for a plasma in
a heterogeneous magnetic field B the authors find a system of equations for
two-fluid anisotropic magnetic hydrodynamics with consideration of terms on
the order of $1/B^2$, in particular the tensor of magnetic viscosity and thermal
fluxes. These equations include those of zero, first and second approxima-
tion. They also discuss the one-liquid approximation. References 7: 6
Russian, 1 Western.

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EXAMPLES OF THE SIMPLEST BOUNDARY CONDITIONS FOR CONCENTRATIONS OF ELECTRONS
AND IONS AND FOR TEMPERATURES OF ELECTRONS AND HEAVY PARTICLES

GOGOSOV, V. V., and SHCHELCHKOVA, I. N., Moscow

[Abstract] Examples of boundary conditions for particle fluxes and tempera-
tures are considered for certain special cases. It is assumed that the prob-
lem of distribution of electron concentration close to a wall has been solved
in the one-dimensional approximation where the electron concentration at a
certain distance from the wall and the temperature distribution are known.
It is assumed that when a quasi-neutral plasma is in contact with a solid
surface there may be a charged layer near the wall with thickness less than
the mean free path. It is shown that conditions proposed in previous papers
can be used for any plasma component (see V. V. Golosov, I. N. Shchelchkova,
"Derivation of Boundary Conditions for the Concentrations, Velocities and
Temperatures of the Components of a Partially Ionized Plasma with Considera-
tion of the Drops in Potential Close to the Wall," Izv. AN SSSR, MZhG, No 5,
1974; V. V. Gogosov, I. L. Pankrat'yeva, I. N. Shchelchkova, "Equations of a
Partially Ionized Non-Quasineutral Plasma with Different Temperatures of the
Components. Boundary Conditions. The Problem of a Probe in a Dense Plasma
with Different Temperatures. Attenuation of Weak Waves," Otchet In-ta
Mekhan. [Report of the Institute of Mechanics], Moscow State University,
No 1491, 1974). Generally speaking, the boundary conditions on the same wall
will be different for each of the components. References 4: 3 Russian, 1
Western.

USSR

RELAXATION OF HIGH-CURRENT ELECTRON BEAMS AND MODULATION INSTABILITY

GALEYEV, A. A., SAGDEYEV, R. Z., SHAPIRO, V. D., and SHEVCHENKO, V. I., Institute of Space Research, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The modulation instability of beam-resonance plasma noises becomes substantial during the relaxation of high-current high-energy beams in a plasma. The short-wave pumping of oscillations caused by this instability substantially prolongs the process of collective beam relaxation. The authors obtain and solve the equations which describe the relaxation dynamics under these conditions. They investigate the case of nonrelativistic and relativistic beam energies. Figures 3; references 18: 15 Russian, 3 Western.

Molecular Physics

USSR

ON THE MECHANISM OF COLLISIONLESS DISSOCIATION OF MOLECULES IN A STRONG INFRA-
RED LASER FIELD

PLATONENKO, V. T., Moscow State University imeni M. V. Lomonosov

[Abstract] The author proposes a new mechanism of laser photodissociation of
molecules with degenerate vibrational modes. The proposed mechanism takes
account of the possibility of conversion of a considerable part of the exci-
tation energy to rotational energy, thus explaining rapid quasiresonant exci-
tation of a molecule in the high-energy region. This possibility does not
depend on interaction between different vibrational modes, and is due to pe-
culiarities of the spectrum that are associated with non-random degeneracy.
These peculiarities are discussed on the basis of the example of molecules
of octahedral symmetry type SF_6. It is shown that the threshold intensities
for dissociation of molecules of low symmetry by this process should be high-
er than for highly symmetric molecules with the same number of atoms. Refer-
ences 5: 3 Russian, 2 Western.

USSR   UDC 539.194

INTERPRETATION OF MEASUREMENTS OF INTRAMOLECULAR EXCHANGE OF VIBRATIONAL
DEFORMATION QUANTA IN THE CO_2 MOLECULE

SHVED, G. M.

[Abstract] Collisional rates of vibrational (V - V) exchange between the $2\nu_2$
states of CO_2 -- 02^00, 02^20 and 10^00 -- are analyzed with exposure of the
gas to laser emission on 9.4 and 10.4 μm, and it is shown that interpretation
of measurements by this technique must account for two transitional channels
of emptying of state 02^00 -- $02^00 \rightarrow 10^00$, and $02^00 \rightarrow 02^20 \rightarrow 10^00$. References 7:
1 Russian, 6 Western.

NEUTRAL CURRENTS AND ELASTIC SCATTERING OF NEUTRINOS AND ANTINEUTRINOS BY A
POLARIZED PROTON TARGET

DZHAFAROV, I. G., Institute of Physics, Academy of Sciences AzerbSSR

[Russian abstract provided by the source]

[Text] Based on Weinberg-Salam calibration theory the authors examine pro-
cesses of elastic scattering of neutrinos and antineutrinos by a polarized
proton target. Expressions are found for differential cross sections, spin
asymmetry and the degree of polarization of the recoil protons in these re-
actions. The resultant formulas are analyzed with consideration of the most
recent experimental data on the Weinberg parameter. References 12: 4 Russian,
8 Western.

RELAXATION OF INDUCED COMPTON SCATTERING WHEN RADIATION FLUX PROPAGATES IN AN
ELECTRON GAS

LYSIKOV, YU. I., Voroshilovgrad Machine Building Institute

[Russian abstract provided by the source]

[Text] The author investigates the relaxation process of reaching efficient
induced Compton scattering when a powerful radiation flux is incident on an
electron gas that occupies part of space. The temperature dependence of scat-
tering effectiveness results in a fall-off of scattering effectiveness with
increasing time from the beginning of propagation. Possible manifestations
of this effect in astrophysical observations are discussed. References 4
(Russian).

USSR

INFLUENCE OF π-CONDENSATE ON ONE-NUCLEON ABSORPTION OF SLOW PIONS BY ATOMIC NUCLEI

TROITSKIY, M. A., KOLDAYEV, M. V., and CHEKUNAYEV, N. I., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] The theoretical problems involved in calculating the π-meson condensate are discussed, and it is shown that the existence of the condensate in actual nuclei can be decided only by direct experiment. Regardless of the outcome, such an experiment would enable more rigid determination of the critical density, and more definite indication of the region of existence of nuclei with anomalous density. It is suggested that the required critical experiment might be measurement of the probability of one-nucleon absorption of a slow pion by atomic nuclei. It is shown that the presence of π-condensate would appreciably increase the probability of slow pion absorption by nuclei. It is concluded that experiments on measurement of the probability of emission of a nucleon with energy in the 140 MeV region should decide the issue. References 8: 7 Russian, 1 Western.

USSR

PARTICULARS OF INTERACTIONS OF RELATIVISTIC COSMIC RAY NUCLEI OF THE IRON GROUP WITH SILVER AND BROMINE NUCLEI WITH MAXIMUM NUMBER OF INTERACTING NUCLEONS

BARANOV, D. G., BOBKOV, V. G., VARYUKHIN, V. V., GAGARIN, YU. F., IVANOVA, N. S., KULIKOV, V. N., LYAGUSHIN, V. I., MYSHKIN, V. YE., KHILYUTO, I. G., and YAKUBOVSKIY, YE. A., Physico-Technical Institute imeni A. F. Ioffe, Academy of Sciences USSR

[Abstract] Research is done in connection with hypotheses concerning the possibility that a shock wave may arise with an increase in the density of nuclear matter by a factor of 3-7 in high-energy interacting nuclei. Since the most favorable conditions of applicability of the hydrodynamic approach are brought about in collisions involving the greatest number of nucleons, it is important to distinguish such events in experiments and to study their peculiarities. The authors investigated 45 interactions of cosmic ray nuclei having energy of 1 Geb/nucleon or more and atomic number of 10 or more with Ag and Br nuclei in a relativistic emulsion. The events were selected by the

criterion $N_h \geqslant 28$, where $N_h = N_g + N_b$, N_g is the number of protons with energy between 31 and 500 MeV, N_b is the number of protons and α-particles with energy between 31 and 220 MeV per nucleon. This corresponds to collisions of nuclei where the number of interacting nucleons of the incident nucleus is of the order of 20 or more. Of the 45 events, 27 involved nuclei with atomic numbers of 22-26. Every strongly ionizing outgoing particle was analyzed with respect to free path and ionization. Angular distributions were measured for different energy ranges of the outgoing particles, and for different incident nuclei. The mean characteristics for events with interacting nucleons of the order of 40 or more showed a smaller number of α-particles and incident nucleus fragments, a greater number of protons with energy of 31-500 MeV (chiefly recoil protons), a greater number of protons with energy of 380-500 MeV (chiefly interacted protons of the incident nucleus), fewer low-energy particles and fragments of the target nucleus, and a large set of generated mesons $\overline{(n_s-Z)}$, where n_s is the number of charge particles with ionization $I > I_o$, I_o is the minimum ionization of a relativistic singly charged particle. Events with about 40 interacting nucleons are a special type of complete spallation of silver and bromine nuclei with maximum percentage of protons having energy of 31-500 MeV (about 80%). These interactions show no irregularities in the angular distributions of secondary particles at 60-66°, which Baumgardt et al attribute to the formation of a Mach shock wave. The experimental data indicate an explosive spallation process which may be amenable to the hydrodynamic approach. References 9: 3 Russian, 6 Western.

USSR

NEUTRON COLLISIONS IN A THERMONUCLEAR PLASMA

ZEL'DOVICH, YA. B.

[Russian abstract provided by the source]

[Text] A method is proposed for diagnosing a developed thermonuclear plasma from combustion of a tritium-deuterium mixture by registration of anomalous neutrons with energy greater than 14 MeV. Estimates show that with the release of more than $3 \cdot 10^{16}$ ergs of energy in a single act (combustion of 0.01 g of mixture), an appreciable percentage of neutrons acquire energy in excess of 14 MeV.

USSR

CONCERNING THE INFLUENCE OF MODULATION INSTABILITY ON RELAXATION OF A RELATIVISTIC ELECTRON BEAM IN A PLASMA

ZAKHAROV, V. YE., L'VOV, V. S., and RUBENCHIK, A. M., Institute of Automation and Electrometry, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The spectra of Langmuir oscillations stimulated by a relativistic electron beam are singular in k-space. In this paper the authors study the influence that the modulation instability of such spectra has on relaxation of an electron beam. It is shown that instability broadening of the spectrum of these oscillations reduces the energy flux into the plasma, lowers the turbulence level and lengthens relaxation. References 9 (Russian).

USSR   UDC 533.933

LOCAL MEASUREMENTS OF THE ELECTRON ENERGY SPECTRUM IN A PLASMA

ALTYNTSEV, A. T., and KRASOV, V. I., Siberian Institute of Terrestrial Magnetism, the Ionosphere and Radio Wave Propagation, Siberian Department of the Academy of Sciences USSR

[Abstract] The paper describes a technique for measuring the energy spectrum of electrons with high spatial (3-5 mm) and time ($\sim 10^{-8}$ s) resolution from the bremsstrahlung of a plasma. The design of a multichannel x-ray receiver is given as well as the energy spectrum of electrons in a collisionless neutral plasma layer produced on the "UN-Feniks" installation in theta-pinch geometry with colliding magnetic fields. Effective heating of the plasma is localized in the vicinity of the zero line of the magnetic field. It was found that the energy spectrum of the electrons differs from maxwellian distribution in an increased number of electrons with energy greater than $10T_e$. This result confirms the hypothesis of development of small-scale turbulence in the layer. The formation of the spectrum is influenced considerably by reconnection of magnetic force lines, which suppresses longitudinal heat conduction in the layer. References 10: 9 Russian, 1 Western.

THE SPACE KINETICS OF A PULSED ZERO-POWER REACTOR

KLIMOV, A. D., STRAKHOVSKAYA, L. G., FEDORENKO, R. P., and CHIKHLADZE, I. L.,
Moscow

[Russian abstract provided by the source]

[Text] A method is proposed for integrating equations of space kinetics that
describe the evolution of neutron and temperature fields during the neutron
surge in a pulsed zero-power reactor. An approximate construction of the
solution is proposed that makes use of the physical particulars of the de-
scribed process--different scales of rates of change in the distribution
functions of fast and thermal neutron fluxes, particulars of the feedback
mechanism. An analysis is made of the precision of the approximation that
is used; a qualitative description is given of the numerical algorithm for
integration of the initial system of equations, and an example of a numerical
experiment is presented. References 6: 4 Russian, 2 Western.

INVESTIGATION OF RADIATION POLARIZATION OF BEAMS IN THE VEPP-2M STORAGE RING

SEREDNYAKOV, S. I., SKRINSKIY, A. N., TUMAYKIN, G. M., and SHATUNOV, YU. M.,
Institute of Nuclear Physics, Siberian Department, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] An experimental study is done on the radiation polarization of beams
on the VEPP-2M electron-positron storage ring. The polarization of a single
beam was measured by the change in counting rate of particles scattered with-
in a bunch with resonance depolarization by an external electromagnetic field.
The resultant experimental values of time and degree of polarization agree
with theoretical predictions. It is shown that the beam can cover an energy
range of 450-670 MeV without disruption of polarization. It is also shown
that polarization is maintained in the presence of an intense counter beam.
References 15: 13 Russian, 2 Western.

USSR

MEASURING THE DISTRIBUTION OF ELECTRON TEMPERATURE AND CONCENTRATION IN A
PLASMA ON THE TM-3 TOKAMAK BY THE METHOD OF SCATTERING OF LASER EMISSION

SANNIKOV, V. V.

[Russian abstract provided by the source]

[Text] The temperature of 0.5-1.2 keV electrons is measured at plasma densi-
of $\bar{n}_e$ = $6 \cdot 10^{12}$-$6 \cdot 10^{13}$ cm^{-3} under stable discharge conditions on the TM-3
tokamak by a Thomson scattering method. The distributions of electron tem-
perature and density with respect to the radius of the discharge column are
determined for different plasma parameters. The time change in the electron
density and temperature profile of the plasma is plotted for one set of
standard conditions (H_z = $1.75 \cdot 10^6$ A/m, I = 50 kA, $\bar{n}_e$ = $6 \cdot 10^{13}$ cm^{-3}). Dia-
magnetic and laser measurements are compared. References 13: 7 Russian, 6
Western.

USSR   UDC 621.384.633.8

SPLIT MICROTRON INJECTOR FOR THE 'PAKHRA' SYNCHROTRON

ALEKSEYEV, V. I., BELOVINTSEV, K. A., BYKO, V. A., VORONKOV, R. M., KAREV,
A. I., and KURAKIN, V. G., Radio Engineering Institute, Academy of Sciences
USSR, Moscow

[Russian abstract provided by the source]

[Text] The authors consider the main parameters and components of a split
microtron designed for use as an injector in the "Pakhra" synchrotron. The
microtron consists of two 180° rotating electromagnets that create a uniform
magnetic field with induction of 0.4 T and a linear accelerator section that
operates in the traveling wave mode with phase velocity equal to the velocity
of light. The design parameters of the microtron are electron energy of 25
MeV at a current of 0.5 A and pulse duration of 6 µs, giving a flux of up
to $2 \cdot 10^{11}$ electrons per pulse. The use of a "transparent" electron gun appre-
ciably simplifies the microtron design, and eliminates the complicated in-
flector unit. The microwave supply of the microtron is provided by a KIU-
15 pulse klystron amplifier. Reasons are given for selection of the individu-
al parameters of the microtron, and variational characteristics are presented.
References 7: 6 Russian, 1 Western.

USSR   UDC 621.039.5

PULSED FAST REACTORS

Moscow IMPUL'SNYYE REAKTORY NA BYSTRYKH NEYTRONAKH in Russian, Atomizdat 1976
248 pp

SHABALIN, YE. P.

[Text] The book generalizes considerable material of a theoretical and ex-
perimental nature accumulated in the Soviet Union and other nations over a
nearly 20-year period of utilization of pulsed fast reactors with both peri-
odic and aperiodic action. Contents: Ch. 1. Pulsed Reactors (PR) with Self-
Quenching Action; Ch. 2. Kinetics of Pulsed Reactors with Self-Quenching
Action; Ch. 3. Effects of Heat Shock in Fast PRs; Ch. 4. PRs with Periodic
Action; Ch. 5. Neutron Physics Theory of PRs with Periodic Action; Ch. 6.
Reactivity Modulation in PRs with Periodic Action; Ch. 7. Fluctuations in
PRs of Periodic Action; Ch. 8. Principles and Problems of Controlling and
Shielding PRs of Periodic Action; Ch. 9. Boosters; Ch. 10. PR Installations
for Physics Research. References 188.

USSR   UDC 621.039.5

PRACTICAL PROBLEMS ON UTILIZATION OF NUCLEAR REACTORS. SECOND REVISED AND
EXPANDED EDITION

Moscow PRAKTICHESKIYE ZADACHI PO EKSPLUATATSII YADERNYKH REAKTOROV. IZD.
2-YE, PERERAB. I DOP. in Russian, Atomizdat 1976 296 pp

VLADIMIROV, V. I.

[Text] An examination is made of the physical and technological problems
that arise in operation of a nuclear reactor. The book gives basic computa-
tional expressions, graphs and tables that are necessary for solving problems,
and also standard problems and methods of solving them together with examples.
Conditions of problems for independent solution are presented. Contents:
Ch. 1. The Nuclear Reactor as a Source of Power and Ionizing Radiation; Ch.
2. Power, Operating Period and Energy Resource of a Reactor; Ch. 3. Reactor
Control.

ECONOMY AND RELIABILITY CHARACTERISTICS OF A NUCLEAR ELECTRIC PLANT WITH
FAST REACTOR WITH ONE-WALL AND TWO-WALL STEAM GENERATOR

RINEYSKIY, A. A., PASHICHEVA, M. I., and CHUSHKIN, V. N.

[Text] An investigation is made of the influence that a two-wall steam genera-
tor with helium sublayer has on the technical and economic characteristics of
a nuclear power plant with fast reactor. An examination is made of ways to
increase the temperature difference between the sodium of the second loop and
the water/steam to ensure reasonable dimensions of the two-wall steam genera-
tor. A comparison is made of thermohydraulic, reliability and cost charac-
teristics of a one-wall and two-wall steam generator. It is shown that with
consideration of the high cost of a 1% load factor for fast reactors in the
case where the systems for protection and monitoring of steam generators do
not preclude a "serious" accident, the use of a two-walled steam generator
is economically justified.

CALCULATION OF THE TEMPERATURE FIELD IN A MULTILAYER FUEL ELEMENT

VOSKRESENSKIY, K. D., and TURILINA, YE. S.

[Text] An investigation is made of temperature distribution in an annular
fuel element as a function of time for a given law of variation in volumetric
heat release. The fuel element is cooled by water flowing through the central
tube. The heat transfer equations are solved with the following assumptions:
heat exchange on the outer surface of the fuel element and axial flows in all
parts of the element are vanishingly small; the physical parameters of the
material, temperature of the cooling water and heat transfer coefficients are
constant; the parts of the fuel element are in total thermal contact; in the
contact lining the temperature is constant with respect to radius, and in
the wall of the cooling tube it is linear at every instant. The problem is

solved by the operator method. The solution is found as a rapidly converging series. Temperature distribution with respect to the radius of the fuel element is calculated for specific dimensions and initial conditions.

CALCULATING THE TEMPERATURE FIELD IN A FUEL ROD WITH THE CLADDING PEELING AWAY

KORSUN, A. S., KUDROVA, L. G., and PETROVICH, V. I.

[Text] Heat transfer equations are solved with the following assumptions; the diameter of the fuel element is much less than its length; the temperature of the cooling fluid, heat transfer coefficients, heat conduction and volumetric heat release are constant; peeling of the cladding is accounted for by variable contact conductivity, and is assumed to extend over the entire length of the fuel element. The function of contact conductivity is expanded in a Fourier series for solution of the problem. The infinite system of equations is then replaced by a finite system that is solved on a computer by the method of successive approximations. Temperature distributions with respect to the diameter of the fuel element are found for different locations and degrees of peeling of the cladding.

INVESTIGATION OF TEST CONDITIONS FOR FAST REACTOR FUEL ASSEMBLIES IN A THERMAL
RESEARCH REACTOR. PART I. METHOD OF STUDY

Obninsk ISSLEDOVANIYE USLOVIY ISPYTANIYA SBOROK TVEL BYSTRYKH REAKTOROV V
TEPLOVOM ISSLEDOVATEL'SKOM REAKTORE. CH. I. METOD ISSLEDOVANIYA in Russian,
Power Engineering Physics Institute FEI-677, 1976 14 pp mimeo.

KULIKOV, YU. N., LANTSOV, M. N., and KOZLOVTSEV, V. G.

[Text] A method is considered for studying conditions of loop tests of fast
reactor fuel assemblies in a thermal research reactor. The article gives
the technique for converting the fuel assembly to a cylinder with homogene-
ous distribution of the composition of the assembly, preserving nonhomogeneity
of distribution of heat release and the overall power of the assembly. Ex-
pressions are derived that show the relation between the nonuniformity of
the distribution of heat release and power of the loop assembly on the one
hand, and the composition and dimensions of the assembly on the other hand.

TRACE RADIATION MONITORING CHARACTERISTICS OF HEAVY IONS WITH ENERGY OF 2-10
MeV/NUCLEON

Moscow MIKRODOZIMETRICHESKIYE KHARAKTERISTIKI TYAZHELYKH IONOV S ENERGIYEY
2-10 Mev/NUKLON in Russian 1976 28 pp (manuscript deposited in the All-Union
Institute of Scientific and Technical Information, 1 Oct 1976, No 3489-76
Dep.)

GUBIN, A. T., KOVALEV, YE. YE., and SAKOVICH, V. A., editorial staff of "Radio-
biologiya," Academy of Sciences USSR

[Text] The paper gives the results of calculations by a Monte-Carlo method
for the energy transfer characteristics of monoenergetic heavy ions into micro-
scopic spherical volumes of tissue-equivalent material with dimensions in the
range of 0.05-10 μm. The calculations are done for ions with energies of 2-
10 MeV/nucleon and nuclear charges of from 2 to 18 that are most frequently
used in radiobiological experiments on cells and microorganisms. An examina-
tion is made of the part played by delta electrons when the energy of heavy
ions is transferred into microscopic volumes of material.

ON OBSERVATION OF LONGITUDINAL COHERENT OSCILLATIONS OF PARTICLES BY MEASURE-
MENT OF THE FIELD DISTRIBUTION LENGTHWISE OF THE RESONATORS

BOBYLEV, V. I., KAPCHINSKIY, I. M., KOLOMIYETS, A. A., and KUYBIDA, R. P.

[Text] A report on observation of dependence between the presence of longi-
tudinal coherent oscillations in a linear resonance accelerator and the mag-
nitudes of drops in the accelerating field that are due to beam-loading of
the accelerating resonators. It is pointed out that one may use the distri-
bution of the accelerating field strength to judge optimality of the choice
of injection energy and to determine the phase shift between the rf voltages
in the different resonators.

INTERACTION OF ELECTROMAGNETIC OSCILLATIONS IN AN H-RESONATOR LOADED BY A
PASSIVE RESONANT ELEMENT IN THE FORM OF A METAL LOOP WITH LUMPED CAPACITANCE

BEZRODNYY, YU. G., REPALOV, N. S., KHIZHNYAK, N. A., and SHULIKA, N. G.

[Text] A theoretical and experimental study is done on the influence that a
passive resonant element in the form of a metal loop loaded by a lumped ca-
pacitance has on the electrodynamic characteristics of an H-resonator. It is
shown that such an element is an effective device for controlling the profile
of electric field distribution in the resonator.

TECHNIQUE AND EQUIPMENT FOR STUDYING THE PARAMETERS OF SUPERCONDUCTIVE RESONA-
TORS

VOLCHKOV, O. V., SMIRNOV, V. L., SOKOLOV, B. A., and CHIKATASH, I. A.

[Text] The paper describes a technique and equipment for studying the storage
factor, critical magnetic field and electric field strength of superconductive
E_{01}-resonators in the S-band made from niobium in the temperature range of
1.7-4.2 K with an error of no more than 10%.

INVESTIGATION OF A THERMAL MODEL OF A RESONANT COMPENSATOR

BOMKO, V. A., DEMCHUK, N. I., and RUDYAK, B. I.

[Text] The paper gives the results of modeling of the thermal state of a
compensator in which a heat tube is used to remove heat from the hot end of
the compensator. It is shown that the use of a heat tube for thermostatic
control of a longitudinal resonant compensator simplifies the design of the
thermostatic control system and increases its reliability. Because of the
high precision of thermostatic control, the amplitude and phase character-
istics of the resonator are kept constant.

UDC 539.1.08

A HIGH-CURRENT ELECTRON-POSITRON LINAC WITH REPEATED ACCELERATION OF THE ELECTRON BEAM

[From REFERATIVNYY ZHURNAL FIZIKA No 1, 1977 Abstract No 1V439 by the authors]

[Text] At the Scientific Research Institute of Electrophysical Apparatus imeni D. V. Yefremov an electron-positron linac is being developed; in addition to injection into the synchrotron at the Yerevan Physics Institute, the particle beams of this accelerator will be used for research in the intermediate energy region. The steady-state pulse current is 1.3-1.5 A. Particle energy at maximum current is 120 MeV. Energy scatter for 75% of the accelerated particles is ± 0.2-0.3%. Maximum pulse duration of the electron current is 8 μs. Maximum pulse recurrence rate is 100 Hz. The accelerator is made in the linotron form. The design provides for positron production and acceleration to 200 MeV. A system for monochromaticization of the electron-positron beams is used in the accelerator.

UDC 539.1.08

PRELIMINARY RESULTS ON REGISTRATION OF THE PEAK OF QUASIMONOCHROMATIC PHOTONS FROM ANNIHILATION OF POSITRONS IN FLIGHT ON THE LUE-50 ELECTRON LINAC

VEKSLER, G. G., VERBITSKIY, S. S., DHILAVYAN, L. Z., and OBOZNYY, V. A.

[From REFERATIVNYY ZHURNAL FIZIKA No 1, 1977 Abstract No 1V440 by the authors]

[Text] The paper reports preliminary results on registration of the peak of quasimonochromatic gamma quanta from annihilation of positrons in flight. The measurements were made with a sodium iodide spectrometer. The resultant curve is given for the spectrum of annihilation gamma quanta (line broadening is associated chiefly with the response function of the NaI crystal).

USSR   UDC 539.1.08

ELECTRON GUN FOR THE 'KRION-1' MULTIPLY CHARGED ION SOURCE

Dubna ELEKTRONNAYA PUSHKA ISTOCHNIKA MNOGOZARYADNYKH IONOV 'KRION-1' in Russian,
Joint Institute of Nuclear Research report 13-9584, 1976, 12 pp mimeo.

OVSYANIKOV, V. P.

[Text] The paper describes the design of an electron gun that shapes a mag-
netically bounded electron flux with perveance of 11 $\mu A/V^{3/2}$, current of 2.5 A,
and average current density of ∼30 A/cm^2. The electron gun is designed for
the "Krion'1" cathode-ray source of multiply charged ions, and has been used
in experiments on ionization of carbon, nitrogen, argon and xenon.

USSR   UDC 539.1.08

A SEMIAUTOMATIC SYSTEM FOR MEASURING THE MAGNETIC FIELD OF AN ISOCHRONOUS
CYCLOTRON

Dubna POLUAVTOMATICHESKAYA SISTEMA IZMERENIYA MAGNITNOGO POLYA IZOKHRONNOGO
TSIKLOTRONA in Russian, Joint Institute of Nuclear Research report 9-9545,
1976, 8 pp mimeo.

YEVDOKIMOV, A. K., ZLOKAZOV, V. B., KOZLOV, S. I., KLENIN, B. A., SUKHOV, A.
M., FEFILOVA, S. G., and SHELAYEV, I. A.

[Text] The paper describes equipment for measuring the magnetic fields of
isochronous cyclotrons. A block diagram is given as well as the results of
measurements made during correction of the magnetic field of the U-200 accel-
erator.

RADIANT EMITTANCE MEASUREMENT SYSTEM FOR THE VEPP-3

GAYDUK, A. D., and PESTOV, YU. N.

[Text] The paper describes a radiant emittance measurement system for the VEPP-3 with respect to the e^+e^- scattering process through an angle $\theta \sim 4°$ with accuracy of $\sim 1\%$. The system is compared with conventional monitoring systems.

EXPLOSIVE-ACTION PARABOLIC LENSES WITH FIELDS OF $(2.4-7.9) \cdot 10^7$ A/m

BUDKER, G. I., VILLEVAL'D, G. S., KARASYUK, V. N., and SIL'VESTROV, G. I.

[Text] The paper describes high-current single-action lenses for high-transmission focusing of high-energy particle beams by fields of $(2.4-7.9) \cdot 10^7$ A/m. Criteria are considered for choosing wall thickness and durations of supply current pulses. Methods are given as well as the results of measurements of the deformations of walls, asymmetry and the diameter of the discharge channel, and also the results of tests of lenses with and without a neck, and discharger lenses. A lens lead-in system is described that enables semiautomatic replacement of destroyed elements.

A STATISTICAL METHOD OF SEPARATING π^+-MESONS AND PROTONS

VASIL'KOVA, A. D., GORNOV, M. G., LAPUSHKIN, S. V., PICHUGIN, A. P., PONOSOV,
A. K., PROTASOV, V. P., and SERGEYEV, F. M.

[Text] A method is proposed for determining the fraction of protons among
investigated positive particles on bubble chamber photographs. The method
is based on the difference of probabilities that δ-electrons will show up on
pion and proton tracks. The results of an experimental check of the method
are given on material obtained with the PK-200 freon bubble chamber at Moscow
Engineering Physics Institute.

USE OF BEAM-EXCITED RESONATORS FOR MEASURING THE TIME OF FLIGHT OF PARTICLES

LOMIZE, L. G., RUBTSOV, B. A., and FILIPCHIKOV, L. L.

[Text] The velocity of protons in linacs is measured by the phase difference
of electromagnetic oscillations of two cavity resonators separated from each
other by a drift space of known extent. It is shown that the average velocity
of protons can be judged from the electric length of the coupling feeder at
minimum amplitude of the field at the output of one of the resonators. The
phase shifter in the coupling feeder can be graduated directly in units of
velocity or time of flight.

TEST INPUT OF RF POWER TO PILOT MODELS OF RESONATORS IN THE SECOND SECTION
OF THE LINAC OF A MESON FACTORY

ANDREYEV, V. G., BELUGIN, V. M., GUSLITSKOV, I. K., IVANOV, YU. D., KUL'MAN,
V. T., MIROCHNIK, E. A., POLYAKOV, B. I., DYUKOV, L. V., PIROZHENKO, V. M.,
ROMANOV, B. V., and UKSSUSOV, N. I.

[Text] Experimental stand studies are done on two versions of accelerating
structures for the second section of a "meson factory." Test input of power
to pilot models of each of the structures is implemented by a klystron pulse
power generator with external excitation on a working frequency of 991 MHz.
After conditioning by an rf field for a 20-hour period, the resonators show
stable operation at nominal power levels.

RESULTS OF DEVELOPMENT OF AN RF CHANNEL FOR SUPPLY OF THE FIRST SECTION OF A
MESON FACTORY

ZARUBIN, B. T., MALININ, I. A., MISHCHENKO, A. V., POLYAKOV, B. I., TREBUKHIN,
V. M., UKSUSOV, N. I., and CHERKASHIN, YU. S.

[Text] The paper gives the results of tests of an experimental model of an
rf supply channel for nominal and elevated pulse and average powers to a dummy
load. Difficulties that arise and methods of overcoming them are described.
During tests, the oscillator and modulators showed stable operation on an rf
power output level of 4 MW per pulse with average power of up to 150 kW.

USSR   UDC 539.1.08

A SEVEN-CHANNEL SOURCE OF HIGH-POWER CURRENT PULSES

KOZODAYEV, A. M., SKACHKOV, V. S., and STASEVICH, YU. B.

[Text] A report on development of a seven-channel circuit for pulse supply
to the compressor windings of an installation for studying collective-ion
dynamics. Composite diodes based on thyristors connected in series-parallel
are used for commutation of current pulses with amplitude of from 1 to 30 kA
and duration of 50-1500 μs. The authors analyze the influence that changes
in the parameters of the tank circuit have on the stability of instantaneous
values of the current pulse.

USSR   UDC 539.1.08

SEPARATIVE CASCADE SUPPLY TRANSFORMER FOR HIGH-CURRENT INJECTOR CHARGED
PARTICLE SOURCES

VERBOVSKIY, V. V., VENEVTSEV, I. T., and PTUKHINA, Z. YE.

[Text] The paper describes a power supply for a high-current injector source
under pulsed voltage of 600 kV. The supply is based on a separative cascade
transformer in contrast to the devices conventionally used for such a circuit
with mechanical power transmission and rotating parts. The transformer is
made up of four stages with 150 kVA each, and is insulated for 150 kV between
the primary and secondary windings of each stage.

THE 'IMPUL'S' HIGH-CURRENT ELECTRON ACCELERATOR

KAZANSKIY, L. N., KOLOMENSKIY, A. A., MESKHI, G. O., and YABLOKOV, B. N.

[Russian abstract provided by the source]

[Text] The "Impul's" installation is a first-generation high-current electron
accelerator. The unit produces an electron beam in the single-beam mode with
maximum energy of about 800 keV, current of up to 30 kA, duration of ~40 ns,
and energy capacity of about 700 J. By using two sections, it is possible to
generate two beams with energy of about 700 keV, current of up to 20 kA and
energy capacity of about 400 J either simultaneously or spaced by up to 100
ns. Basic relations are given for choosing the design of the accelerator,
as well as the results of studies and experience in long-term operation.
References 6: 5 Russian, 1 Western.

CALCULATION OF THE CHARACTERISTICS OF A TOKAMAK REACTOR WITH INJECTION OF
DEUTERIUM AND TRITIUM IONS

KARETKINA, N. V.

[Russian abstract provided by the source]

[Text] An investigation is made of the feasibility of developing a reactor
based on a tokamak with high-level injection of deuterium and tritium beams
at a fairly high electron temperature. With consideration of collisions be-
tween fast ions, a system of nonlinear kinetic equations is derived for the
deuteron and triton distribution functions; this system is numerically solved.
Different characteristics of the fusion reactor are calculated: temperature
of each kind of ion, rate of energy transfer from one kind of particle to
another, energy lifetime of the ions, and dependence of these parameters on
electron temperature and particle lifetime. A relation is also found for the
way that the ratio between thermonuclear and injected power depends on the
energy of injected deuterons when the triton energy is a constant 40 keV. It
is shown that this ratio reaches a maximum at an injected deuteron energy of
very nearly 100 keV. References 11: 6 Russian, 5 Western.

INVESTIGATION OF THE BEHAVIOR OF HOT WASTE FROM REPROCESSING OF FAST-REACTOR FUEL ELEMENTS BY THE GAS FLUORIDE METHOD

KIRILLOVICH, A. P., LAVRINOVICH, YU. G., SKIBA, O. V., VOROBEY, M. P., and STAROZHUKOV, D. I.

[Russian abstract provided by the source]

[Text] The paper gives the results of studies of some physicochemical and radiation properties and the behavior of solid radioactive waste. The characteristics of the experimental stand and the study method are described. Measurement data are given on the energy release of irradiated fuel and waste, and the heat balance of fission products is presented. Radiation gas emission is determined on the basis of one year of observations. The release of radionuclides into the gas phase from the solid waste is measured, and the degree of contamination of the gas phase during storage of the waste is calculated. It is concluded that high-level waste should be hermetically sealed when stored for long periods under controlled conditions. References 6 (Russian).

ENERGY SPECTRA OF ELECTRONS AND ANTINEUTRINOS FROM FRAGMENTS OF ^{235}U AND ^{239}Pu FISSIONED BY THERMAL NEUTRONS

BOROVOY, A. A., DOBRYNIN, YU. L., and KOPEYKIN, V. I., Institute of Atomic Energy imeni I. V. Kurchatov

[Russian abstract provided by the source]

[Text] To choose among the different versions of the theory of weak interactions we need more accurate information on neutrino experiments. For reactor experiments, this necessarily involves adequate knowledge of the energy spectrum of $\bar{\nu}_e$ of ^{235}U fission fragments. In addition, in most of the equipment used for this purpose there is considerable accumulation of ^{239}Pu and therefore the $\bar{\nu}_e$ spectrum may be distorted with the passage of time. Steady-state energy spectra are calculated for antineutrinos and electrons emitted by fragments of ^{235}U and ^{239}Pu fissioned by thermal neutrons. It is shown

that the spectra of leptons from ^{239}Pu fission products are considerably soft-
er than the analogous spectra of ^{235}U. Calculations of the cross sections of
processes averaged with respect to $\overline{\nu}_e$ spectra for ^{235}U and ^{239}Pu indicate that
this difference must be taken into consideration when carrying out quantita-
tive neutrino experiments. The authors thank L. A. Mikaelyan, S. A. Fayans,
F. Ye. Chukreyev and Yu. I. Grigor'yan for useful discussions. Figures 5;
table 1; references 12: 3 Russian, 9 Western.

OPTIMIZATION OF PHOTON-ELECTRON INTERACTION FOR COMPTON SCATTERING OF LASER
EMISSION BY A RELATIVISTIC ELECTRON RING

GLEYZER, S. M., NECHAYEV, B. A., and PESHKOV, A. V., Scientific Research Insti-
tute of Nuclear Physics Affiliated with Tomsk Polytechnical Institute imeni
S. M. Kirov

[Abstract] Attention has recently been focused on development of high-density
relativistic electron rings for collective-ion acceleration and plasma con-
tainment experiments. To produce and use a relativistic electron ring, one
must know its position in the chamber, the energy distribution of the elec-
trons in the ring and the electron density with respect to cross section at
any instant. These parameters can be determined from the Compton backscatter-
ing of a coherent light beam by the relativistic electrons in the ring. The
figure shows a diagram of the proposed technique.

Luminous flux from laser 1 at a certain angle θ_1 is prefocused by lens 2 and
sent to chamber 3 where it is incident on electron ring 4. The scattered
Compton radiation is coupled out through tube 5 and recorded by instrument 6.
A model problem is solved on reconstructing the electron energy spectrum from
the scattered laser photons when the parameters of the electron ring are pre-
determined. An analytical relation is derived for the spectrum of the

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reflected laser light as a function of the given beam parameters. The maximum yield of scattered radiation occurs when $\theta_1 = 180°$ and the scattered photons travel parallel to the initial electron momentum. The frequency of the reflected light increases with θ_1 and is beyond the visible band when this angle is greater than 90°. References 7: 6 Russian, 1 Western.

VOLKOV, V. G., KOL'CHUZHKIN, A. M., LAPPA, A. V., and SHTEYN, M. M., Scientific Research Institute of Nuclear Physics Affiliated with Tomsk Polytechnical Institute imeni S. M. Kirov

[Abstract] Theoretical and experimental research is done on the radiation fields of narrow beams for the two most typical collimated sources--an isotropic point source (conical beam), and a unidirectional disk source (cylindrical beam). The sources were a monoenergetic source ($E_0 = 0.661$ MeV) and a source with a bremsstrahlung spectrum ($E_{max} = 0.7, 2, 6$ and 15 MeV). The absorbers were aluminum and water. Radial flux distributions were calculated by a Monte Carlo method. The results show a peak of unscattered emission inside the initial radius of the source, which may appreciably exceed the scattered radiation for small sources. For a cylindrical beam the relative height of this peak is nearly independent of depth, and for conical beams it falls as the reciprocal of the depth. The contribution of the scattered flux component increases with increasing size of the source. For practical purposes, the radial flux distributions for narrow cylindrical beams are determined by the radial distribution of a thin beam and the relative height of the peak of unscattered radiation. The theoretical conclusions are confirmed by experiments with a Cs^{137} source and a small betatron. References 10 (Russian).

USSR

INFLUENCE OF TRAPPED ELECTRONS ON ODD 'DRIFT' MODES IN A TOKAMAK

MAZUR, V. A., MIKHAYLOVSKIY, A. B., and SHUKHMAN, I. G., Institute of Atomic Energy imeni I. V. Kurchatov

[Russian abstract provided by the source]

[Text] The authors investigate odd "drift" modes in a tokamak that were previously discussed in a number of papers by Coppi. They demonstrated that Coppi's concepts on the mutual independence of even and odd modes are generally invalid. Thus the odd modes just as the even ones are sensitive to dissipation on trapped electrons although to a lesser degree than the even ones. They showed that one of the physical factors leading to linkage of the odd modes with the even ones is the compressibility of the plasma. They also showed that the odd modes are linked with the even ones when the compressibility is ignored if a fractional number of wavelengths fits along the torus. The increments or decrements of the odd modes are small in comparison with those of the even modes, however the authors found that they may be substantial in problems on the buildup of odd modes by a group of fast ions in a two-component tokamak since the increments of such a buildup are also small. It is just such a situation that arises in the fast-ion buildup of the odd modes studied by Coppi and Bhadra. They conclude that the theory of collective processes in a two-component tokamak requires reexamination. References 17: 7 Russian, 10 Western.

HUNGARY

INVESTIGATION OF THE CLUSTER STRUCTURE OF ATOMIC NUCLEI BY MEANS OF HIGH-ENERGY PROTONS

ERO, JANOS, Main Nuclear Physics Department, KFKI [Central Research Institute of Physics]

[Abstract] This review article discusses the observation made in Dubna some years ago that particles develop under the influence of 670 MeV protons when they scatter at low angles: both elastically scattered protons and particles with a higher momentum than the primary protons are evident. Subsequently the latter particles were identified as deuterons. This phenomenon may be used to study the cluser structure of atomic nuclei. The cluster structure means that there may be various nucleon associations (deuteron, triton, alpha particle and the like) within the atomic nuclei. A plane-wave pulse approximation theory was developed to explain the findings and to permit their interpretation. Experimental studies were carried out to elucidate the high-energy knock-on reactions involved. The experimental setup used was also employed to examine the $^6Li(p,pd)^4He$ reaction. Scientists at the KFKI participate in these studies, being carried out in many institutions in the world. Figures 5.

HUNGARY

ION-IMPLANTATION STUDIES

GYULAI, JOZSEF, Main Solid-State Physics Department, KFKI [Central Research Institute of Physics]

[Abstract] The projects carried out at the KFKI in cooperation with the Kurchatov Institute in Moscow are briefly described. The equipment used includes a particle accelerator with adequate energy stability, a goniometer which is accurate to a one-hundredth of a degree, particle detector with adequate resolution, amplifiers, and a multichannel analyzer. The following projects were completed or are in progress: determination of oxygen and the chemical analysis of oxygen-containing compounds (based on the fact that the resonance of the Rutherford effective cross section of the 3.05 MeV He^+ ions scattered by oxygen may be measured), determination of implanted boron (using the $^{10}B(n,alpha)^7Li$ reaction); elucidation of implantation as a pre-diffusion addition; thinning of silicon crystals by so-called anodic layer removal in 40-60 Å steps combined with activation analysis to establish precise distribution diagrams on implanted specimens; use of infrared for evaluating the implant layers; and practical applications arising from the foregoing projects. Figures 9; no references.

HUNGARY

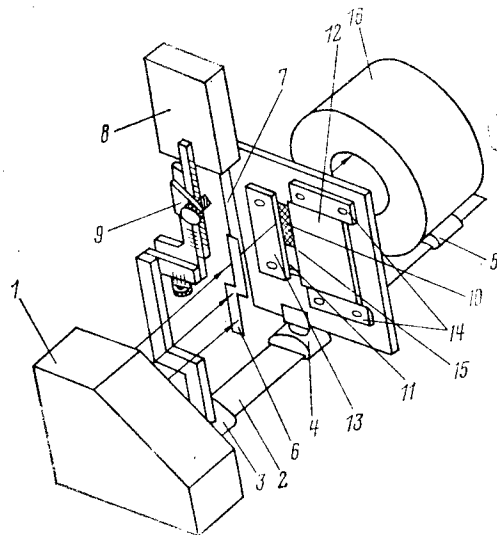THE RECONSTRUCTED REACTOR OF THE CENTRAL RESEARCH INSTITUTE OF PHYSICS [KFKI]

[Abstract] The reconstruction of the VVR-S research reactor installed in March 1959 is briefly described. The reconstructed reactor, designated VVR-SM, now has doubled thermal neutron flux, and is better suited for irradiation and experimental work. The reconstruction was completed in 1967. A new fuel assembly was installed, and the original H_2O neutron reflector was supplemented by a beryllium ring. The new vertical irradiation channels for isotope preparation were placed within the Be reflector; the horizontal channels are fed from there. Practically all isotopes capable of being made are now produced in the reactor. About half of the isotopes are for medical applications. Neutron-activation analysis, agricultural studies, scientific research, and similar operations account for the use of the rest. With the improved fuel assemblies, 10 MW heat release may be achieved; however, the present cooling system permits the utilization of only up to 5 MW at the moment. The specifications of the old and reconstructed reactor are tabulated. Figures 2; table 1.

A TECHNIQUE FOR STUDYING THE ELECTRO-OPTICAL PROPERTIES OF MICROSCOPIC OBJECTS

MINAYEV, S. M., and GERT'YE, A. F.

[Abstract] A method is described for measuring the absorption spectra of microscopic objects under conditions of light diffraction in an electric field. The object is placed between the blades of a slit that has adjustable width in one part and serves as a reference standard in the other part. Electric voltage is applied to the blades, which are insulated from each other. The figure shows a diagram of the device used to realize this technique.

This device consists of a monochromatic illuminator 1 to which a rail 2 is fastened. The rail carries pedestals 3-5. A modulator 6 is fastened to the armature 7 of polarized relay 8, which is linked to specimen driver 9. Fastened to pedestal 3 is a specimen driver that is used to locate the modulator with respect to the slit. Modulator 6 and relay 8 are used for alternate transmission of the light flux through the part of the slit 10 in which the object is located, or through the free (reference) part of the slit 11. The slit is formed by two parallel blades 12, 13, one of which (12) is movable. The movable blade slides along guides 14. Screen 15 divides the slit into two parts 10 and 11. The blades that form the slit are carried on pedestal 4. A photosensitive cell 16 is carried on pedestal 5. The monochromatic light flux from source 1 passes through modulator 6 to the slit. Fluxes passing through object 10 and reference 11 are registered by cell 16, and the optical density is determined by comparing them. The procedure for locating the microscopic object in the slit is described. Experiments show that the response of the device is linear from a wavelength of 0.8 μm to a slit width of 2 μm. Linearity with respect to optical density is observed up to 2.3 μm. References 3 (Russian).

USSR UDC 535.376

ON THE NATURE OF ELECTROCHEMILUMINESCENCE BRIGHTNESS WAVES

PODGORNAYA, L. M., and LEONOV, V. P.

[Russian abstract provided by the source]

[Text] An examination is made of the nature of the two brightness waves and the afterpulse of electrochemiluminescence of 1,5-diphenyl-3-styrylpyrazoline in a solution of dimethylformamide with LiCl electrolyte. During the anode phase, three types of electron acceptors--Cl, Cl_2 and R^+--are formed on the surface of the working electrode. A light flash arises during the cathode phase; the enumerated acceptors and the R^- ions formed take part sequentially in formation of the brightness waves of this light burst. Excited molecules of R^- may be formed with transfer of an electron from the upper bonding orbital of the R^- to an acceptor. During the afterpulse the electron acceptor is the positively charged electrode. References 14: 7 Russian, 7 Western.

USSR UDC 533.9.082.5:543.42

HOMOLOGY AND CONCENTRATION SENSITIVITY IN EQUILIBRIUM EXCITATION

SERAPINAS, P. D., and SHALKAUSKAS, YU. S.

[Russian abstract provided by the source]

[Text] An examination is made of the way that the ratio of intensities of the spectral lines of two chemical elements depend on temperature and composition in a homogeneous optically thin plasma under conditions of local thermo-dynamic equilibrium. Numerical calculations of such dependences are done for a number of lines of ions of aluminum and nitrogen.

On the basis of specific examples, the authors discuss the conditions of line homology, and estimate the temperature ranges of homology and the concentration sensitivity insofar as they are determined by ionization and excitation in the plasma.

The results can be applied both to determination of the relative composition of the plasma and to quantitative spectral analysis. References 8: 2 Russian, 1 Polish, 5 Western.

AFOCAL MIRROR SYSTEMS WITH UNSHIELDED ENTRANCE PUPIL

KUDRINA, N. K., Leningrad Institute of Precision Mechanics and Optics

[Text] One of the disadvantages of mirror systems is shielding of the central part of the entrance pupil. Afocal systems without shielding can be made on the basis of so-called eccentrically cutout paraboloids in which the aperture diaphragm is shifted in the meridional plane, while the central point of the field is located on the optical axis. At the same time, the entire system remains centered, while the diaphragm is placed off-center by a distance that is commensurate with its own size. Mersenne telescopic systems are considered that have two and four reflections from the mirrors. Formulas are derived for size calculation of afocal mirror systems with unshielded entrance pupil. Afocal fittings made on the basis of such systems do not introduce any aberrations for a point on the axis, and aberrations of off-center placement are vanishingly small. The paper gives the results of calculation of a number of systems for different values of apparent magnification, and relations are also derived that define the maximum field of view. It should be noted that for the same angle of the field of view, vignetting of oblique beams in a double Mersenne system is considerably greater than in two-mirror systems. Afocal fittings based on the Mersenne system with unshielded entrance pupil of high multiplicity can be used only for angular fields $2w \leqslant 1°$. With an increase in the field of view, afocal fittings operate at an apparent magnification of $3x - 5x$.

INVESTIGATION OF THE PRINCIPLES THAT GOVERN DISPLACEMENT OF AN OPTICAL IMAGE IN A CLOUDY ATMOSPHERE

IVANOV, A. P., associate member of the Academy of Sciences, BSSR, GAVRILOVICH, A. B., GANICH, P. YA., candidate of physical and mathematical sciences, and BOYKO, P. B., Institute of Physics, Academy of Sciences BSSR, Institute of Electronics, Academy of Sciences BSSR

[Russian abstract provided by the source]

[Text] The paper gives the results of an experimental study on model systems of the principles that govern displacement of an optical image in a cloudy atmosphere with consideration of vertical nonhomogeneity of the atmospheric aerosol, the shape of the scattering curves for clouds and haze, and the

shape of the underlying surface. An investigation is made of the way that the contrast in the image of an object depends on the optical density of clouds and haze, the altitude of the lower boundary of a cloud and the albedo of the underlying surface for cases of observation on vertical and horizontal paths. The results are given in dimensionless form, which enables generalization to full-scale systems. References 14: 13 Russian, 1 Western.

AN IONIZATION CHAMBER STUDY OF PLASMA FOCUS EMISSION IN THE VACUUM ULTRAVIOLET REGION

ZVORYKIN, V. D., KAMRUKOV, A. S., KLEMENTOV, A. D., KOZLOV, N. P., MALASH-CHENKO, V. A., PROTASOV, YU. S., and ROZANOV, V. B., Moscow Higher Technical Academy imeni N. E. Bauman, Physics Institute imeni P. N. Lebedev, Moscow

[Russian abatract provided by the source]

[Text] Double ionization chambers are used to study plasma focus emission of a magnetoplasma compressor of erosion type in the quantum energy region of 10-70 eV. Emission maxima are recorded that are associated with recombination of electrons to the ground state for ions with single, double, triple and higher multiple charges. It is shown that the plasma focus in the 21-70 eV region radiates 45% of the total emitted energy, and can be used as an effective source of far ultraviolet emission to create an inverse medium for photoionization of electrons in the inner shells of an atom. The authors thank P. A. Ovchinnikov and A. G. Opekan for assistance with the experiment and with development of the ionization chambers. References 19: 15 Russian, 4 Western.

USSR

OBSERVATION OF RADIOFREQUENCY COHERENCE IN THE EXCITATION OF TRANSITIONS OF
THE HYPERFINE STRUCTURE OF OPTICALLY ORIENTED ATOMS

VASYUTINSKIY, O. S., DOVATOR, N. A., and ZHITNIKOV, R. A., Physico-Technical
Institute imeni A. F. Ioffe, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] The authors detected radiofrequency coherence of states corresponding
to Zeeman sublevels of optically oriented atoms of cesium in the excitation
of hfs transitions by an amplitude-modulated magnetic microwave field. The
coherent signals were registered both by changing the modulation frequency
and by changing the frequency of the microwave field. The authors established
a different shape for these signals and a different character for their be-
havior as a function of the intensity of the magnetic microwave field. They
made a theoretical study of the observed phenomena and compared the experimen-
tal results with theory. Figures 5; references 8: 4 Russian, 4 Western.

USSR   UDC 539.1.08

A DEVICE FOR AUTOMATIC STABILIZATION OF THE AMPLIFICATION OF A SPECTROMETRIC
CHANNEL

BABAYEV, A. P., BABICHENKO, S. I., RAYKOV, V. S., and SKLYANKIN, V. A.

[From REFERATIVNYY ZHURNAL FIZIKA No 1, 1977 Abstract No 1V542P by L. I.]

[Text] A differential device has been developed for automatic stabilization
of the amplification of a spectrometric channel. The unit is distinguished
by an expanded range of stabilization. The device contains a detector, power
supply, amplifier, two-channel amplitude discriminator with adjacent channels
and a difference instrument for measuring average pulse frequency. The ampli-
tude discriminator consists of threshold stages and two anticoincidence gates.
Expansion of the range of stabilization is achieved by adding a summing pulse
frequency meter and a control stage with two outputs. The input of the sum-
ming pulse frequency meter is connected to the outputs of the anticoincidence
gates, while the output of the meter is connected with the input of the
control stage. The outputs of the control stage are connected in turn to
the threshold stages. A block diagram is given, and the working principle
of the device is described in detail.

STATISTICS OF THERMAL FLUCTUATIONS IN THE OPTICAL ABSORPTION OF GASES

KOZLOV, V. P.

[Russian abstract provided by the source]

[Text] The author presents a theory of thermal fluctuations in the optical absorption of gas. He demonstrates that along with the shot noise, the light passing through a layer of absorbing gas also possesses excess noises associated mainly with fluctuations in the number of absorbing atoms in the space traveled by the light beam. Expressions are obtained for the spectrum and power of excess noises. References 3 (Russian).

THERMAL FLUCTUATIONS IN THE OPTICAL ABSORPTION OF GASES

ALEKSANDROV, YE. B., and MAMYRIN, A. B.

[Russian abstract provided by the source]

[Text] The authors demonstrate experimentally that the intensity of a light beam passing through an absorbing gas is modulated by random law because of the thermal fluctuations in the number of absorbing atoms. The fluctuation spectrum is concentrated in the range of 0 to $(2\pi\gamma)^{-1}$ Hz where γ is the characteristic diffusion time of the atom through the cross section of the beam. The theoretical analysis of the strength of absorption fluctuations agrees with the experimental data. Figures 3; references 5 (Russian).

USSR

SPECTRUM OF HYDROGEN PLASMA AT THE SERIES LIMIT

GUROVICH, V. TS., and ENGEL'SHT, V. S., Institute of Physics and Mathematics,
Academy of Sciences Kirghiz SSR

[Russian abstract provided by the source]

[Text] The authors propose a theory of spectral intensity at the series
limit, based on allowance for the subbarrier ionization of atoms from excited
Stark sublevels in the statistical plasma microfield. The spectral lines
disappear when the probability of ionization is two to three orders of magni-
tude greater than the probability of radiation transport. The permeability
of the potential barrier is much less than unit, thus making perturbation
theory applicable for computing line radiation and the theorem of conserva-
tion of the sum of oscillator strengths in converting the lines to a continuum.
This allows computing the photo-capture spectrum under the disappearing lines.
The authors compare their results with experimental data and simplified models
of the spectrum at the series limit. Figures 5; table 1; references 37: 19
Russian, 18 Western.

NORMAL TRANSVERSE IMPACT AGAINST HELICALLY WOUND WIRE CABLES

RAKHMATULIN, KH. A., and ADYLOV, K. A., Moscow State University, Department of Gasdynamics and Wave Dynamics

[Abstract] Differential equations of motion are derived for a helically wound wire cable with consideration of the correlation between longitudinal and torsional strains. The general solution of these equations is found for point transverse impact. It is shown that part of the cable at each instant is rectilinear in shape, and in this section elastic waves propagate with constant velocities a_1 and $a_2 < a_1$. Behind this rectilinear section is another section in which motion is uniform and strain is constant. Solutions are written out for these sections. References 9 (Russian).

ON CONDITIONS OF EXISTENCE OF A CURVILINEAR CHAPMAN-JOUGUET DETONATION WAVE

SVALOV, A. M., Moscow State University, Department of Hydromechanics

[Abstract] An asymptotic expansion is found for the solution of the problem of propagation of a Chapman-Jouguet detonation wave that takes the form of an arbitrary surface in space. It is assumed that the wave is the surface of discontinuity of gas parameters where heat release occurs, and that the gas in front of the wave is at rest. It is shown that a necessary condition for existence of a solution is that the sum of the reciprocals of the radii of curvature at every point on the wave surface be non-positive. Geometrically, this means that the wave must expand with time, i.e., converging Chapman-Gouguet waves do not exist. References 8: 6 Russian, 2 Western.

UDC 536.21

TEMPERATURE FIELDS AND STRESSES IN THE CASE OF VARIABLE FLUXES ON A WALL

TSOY, P. V., and ISMATULLAYEV, A. I., Tadzhik Polytechnical Institute

[Abstract] A simple approximate method that gives sufficient accuracy for engineering purposes is described for calculating unsteady heat conduction and thermoelastic stresses for the case of symmetric time-variable boundary conditions of the second kind. The technique involves reducing the initial partial differential equations of the boundary value problem to a linear system of algebraic equations. Results are given for an infinite plate where the heat flux is constant, and where it varies linearly and exponentially. The method can also be used for a cylinder and a sphere. References 3 (Russian).

UDC 532.516.5

PRESSURE DISTRIBUTION IN ELASTOHYDRODYNAMIC CONTACT OF CYLINDERS

GALAKHOV, M. A., and ZAPPAROV, K. I., Moscow Physico-Technical Institute, Dolgoprudnyy, Moskovskaya Oblast

[Abstract] The flow of a viscous incompressible fluid in the narrow gap between rotating elastic cylinders can be described by the system of equations

$$\frac{d}{dx}\left[h^3 \exp(-Lp)\frac{dp}{dx}\right] = 2x + D \int_{a'}^{c} \frac{p(t)}{t-x}dt; \qquad (1)$$

$$h = 1 + x^2 - c^2 + D \int_{a'}^{c} p(t)\ln\frac{c-t}{|t-x|}dt; \qquad (2)$$

$$p(a') = p(c) = \frac{dp}{dx}(c) = 0. \qquad (3)$$

Here x is the coordinate with respect to rolling direction, a' and c are the beginning and end of the region of positive pressure, c is unknown. Linear dimensions along x are referred to $\sqrt{2Rh_0}$, the variable width of the gap h is referred to the thickness h_0 of the film of liquid at x = c, and pressure p is referred to $6\mu_0(u_1+u_2)\sqrt{2Rh_0}/h_0^2$. The viscosity of the fluid μ depends on

the physical pressure p' in accordance with the formula $\mu = \mu_0 \exp(\alpha p')$, u_1 u_2 are the velocities of the surfaces of the cylinders, $R = R_1 R_2 / (R_1 \pm R_2)$, R_1, R_2 are the radii of the cylinders, $L = 6\mu_0 \alpha (u_1 + u_2)\sqrt{2Rh_0}/h_0^2$, $D = 48\mu_0(u_1+u_2)R^2\alpha^2/h_0^2$, $r' = C(1-v^2)$, E is the modulus of elasticity of the cylinders, v is the Poisson ratio. The unknowns in (1)-(3) are p(x), h(x) and the constant c. In this paper a numerical method is proposed and used for solving this system. The functions p(x) and h(x) are determined and the presence of a second pressure maximum is demonstrated. The numerical technique is based on linearization of system (1)-(3) and the use of spline functions of first order. References 11: 10 Russian, 1 Western.

CONCERNING THE TIME IT TAKES FOR LASER EMISSION TO CAUSE DESTRUCTION OF ALUMINUM FILMS

MIKHAYLOV, V. S., and SPASIBENKO, V. A.

[Text] An experimental relation is found for the time of onset of a hole through aluminum films as a function of the density of laser exposure over a wide range. It is shown that the temperature at which destruction of the film begins is above its melting point, but below the boiling point of the material, and increases with increasing irradiation energy density. It is concluded that melting is the predominant mechanism in the process of hole formation.

USSR

DESTRUCTION OF TRANSPARENT DIELECTRICS UNDER THE ACTION OF CO_2 LASER EMISSION

GOLUBEV, V. S., and SNOPKO, V. N., Institute of Physics, Academy of Sciences
BSSR, Minsk

[Abstract] The authors study processes of destruction of NaCl crystals exposed
to pulsed CO_2 laser emission. As the emission flux density on the front sur-
face rose to 10^6 W/cm^2, luminescence was observed inside the specimen as rows
of bright points. After passage of the emission, defects remain in the speci-
men in the form of spherical cavities from which small cracks emanate. The
residual damage occurs at the points of luminescence. The results of the ex-
periments indicate a mechanism of avalanche ionization that develops on crystal
lattice defects. The action of this mechanism shows up both inside the crystal
and on its surface. Development of an electron avalanche inside the dielec-
tric leads to micro-explosions, and on the surface--to formation of a lumin-
escent surface discharge. References 10: 8 Russian, 2 Western.

USSR   UDC 621.3.038.8:539.4

INFLUENCE OF SHORTWAVE ABSORPTION ON THE THRESHOLD OF VOLUMETRIC FRACTURE OF CRYSTALS BY PULSED CO_2 LASER EMISSION

KOVALEV, V. I., and FAYZULLOV, F. S., Physics Institute imeni P. N. Lebedev,
Academy of Sciences USSR, Moscow

[Russian abstract provided by the source]

[Text] A correlation is observed between the thresholds of volumetric fracture
of NaCl, KCl and thallium bromide-chloride crystals under the action of
pulsed CO_2 laser emission and the transmittances of these crystals close to
the shortwave transparency limit. It is shown that such a correlation may be
useful in methods of nondestructive testing of the radiation strength of ma-
terials for high-power infrared lasers. In conclusion the authors thank
Doctor R. Vosk of the Crystal Physics Research Laboratory, Hungarian Academy
of Sciences, and also I. S. Lisitskiy and D. S. Mironov, State Scientific
Research and Planning Institute of Rare Metals, for furnishing the specimens.
Figure 1; references 7: 4 Russian, 3 Western.

UDC 621.378.32:539.2

RADIATION STRENGTH OF SOME OPTICAL MATERIALS EXPOSED TO LIGHT BEAMS OF LARGE DIMENSIONS

BESSARAB, A. V., KORMER, S. B., PAVLOV, D. V., and FUNTIKOV, A. I.

[Russian abstract provided by the source]

[Text] The article gives the results of measurements of the radiation strength of BaF_2, NaCl and CaF_2 crystals, and also KI and KU glasses on a wavelength of 1.06 μm. It is shown that the investigated crystals and KI glasses are characterized by a high level of absorbing inclusions in the body of the specimen. An investigation is made of the way that the surface optical strength of the materials depends on the dimensions of the radiation spot in the range of comparatively large spot dimensions (up to 1 cm). It is found that the surface strength of BaF_2, NaCl and CaF_2 is noticeably lower than that of quartz glasses and K-8 glass. The principles that govern surface fracture are explained within the framework of a probabilistic model of fracture on absorbing inclusions. Figures 2; table 1; reference 1 (Russian).

USSR

ON THE THEORY OF ROTATING SUPERCONDUCTORS

SEDRAKYAN, D. M., MKRTCHYAN, G. S., and SHAKHABASYAN, K. M., Yerevan State University, Institute of Physics Research, Academy of Sciences Armenian SSR

[Russian abstract provided by the source]

[Text] The Ginzburg-Landau equations are derived for rotating superconductors in the thermodynamic approximation. It is shown that when no external magnetic field is present, vortex filaments that rotate as solids together with the superconductor may arise in type II superconductors. Some hysteresis effects are considered in rotating doubly connected type II superconductors. References 12: 8 Russian, 4 Western.

USSR

QUANTUM INTERFERENCE ON Nb_3Sn FILM CONTACTS AT HYDROGEN TEMPERATURES

GOLOVASHKIN, A. I., LEVCHENKO, I. S., DYKOV, A. N., and MAKHASHVILI, L. I., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Russian abstract provided by the source]

[Text] An experimental study is done on Nb_3Sn Josephson junctions made by a technique involving scratching of sputtered films. It is shown that the current-voltage characteristics of the contacts conform to a parabolic law $V = C(I^2 - I_c^2)$, where I_c is the critical current. It is found that the parameter $C \sim 1/I_c$. The velocity of Abrikosov eddies in the junction is estimated. Nb_3Sn quantum interferometers are made that operate at "hydrogen" temperatures. The temperature dependence of the interferometer properties is studied. References 10: 6 Russian, 4 Western.

SUPERCONDUCTIVE PROPERTIES OF TERNARY MOLYBDENUM SULFIDES AND CERTAIN LANTHANUM
ALLOYS

BYCHKOV, YU. F., KRUGLOV, V. S., and LIKHANIN, YU. N.

[Text] Specimens of ternary molybdenum sulfides were produced from powders
of the component elements held for 10 h at 1050°C under vacuum inside quartz
flasks, and the critical temperature and the lattice parameters of these
specimens were measured. Such MMo_3S_4 compounds (M = Al,Ga,In,Si,Ge), not
studied before, do not exhibit any superconductivity above 4.2 K. The maxi-
mum T_c (14.4 K) for $Sn_xMo_5S_6$ compounds corresponds to x = 0.6, with the lat-
tice parameters weakly depending on x. For lanthanum-indium alloys T_c - 6 K,
with up to 20% In, ln $T_c \backsimeq$ 6K indicating that small additions of indium
stabilize the β-phase of lanthanum. Alloys containing 15-20% La exhibit a
second superconductive transition at a much higher T_c, probably due to the
presence of the La_3In phase (the same T_c has been recorded in alloys contain-
ing 30-40% In). For all alloys of the La_3X series (X = B,Si,Ge,Sn,Ga,Al) T_c
is nearly the same and does not exceed 6 K. In the case of quasiternary
$La_3In-La_3Ga-La_3Al$ alloys the maximum T_c corresponds to the $La_3In_{0.8}Ga_xAl_y$
composition.

EFFECT OF NITROGEN ON THE SUPERCONDUCTIVITY OF Nb_3Sn

BYCHKOV, YU. F., GRUZIN, P. L., YEVSTYUKHINA, P. A., ALEKSEYEV, L. A., and
KRUGLOV, V. S.

[Text] The critical temperature T_c of Nb_3Sn cermet was lowered from 17.4 to
5.6 K by heating it to 2000° C within 30 min, and specimens of this material
were repeatedly annealed at temperatures within the 500-1100°C range for 1 h
in a nitrogen atmosphere. This resulted in a wider superconducting transition

and a higher T_c. The lattice period did not change. The Mössbauer spectra of the same specimens were also evaluated. The T_c degrading by 12 K, due to evaporation of tin and its replacement by some of the niobium, had not affected the probability of the Mössbauer effect f or the magnitude of the isomeric shift. Annealing in a nitrogen atmosphere resulted in a larger isomeric shift, the maximum shift noted at 900°C (with T_c = 13.9 K), while the probability f increased monotonically from 0.32 for a specimen with a degraded T_c to 0.56 for a specimen with T_c = 16.8 K. It is suggested that nitrogen atoms occupy the vacancies created by niobium atoms replacing tin atoms, as a result of which the bond between tin atoms and their nearest neighbors becomes stronger. Annealing an original specimen in a nitrogen atmosphere without prior degradation did not affect T_c, however, but decreased f from 0.32 to 0.20.

[Text] Electron-dislocation interaction is analyzed here. The effect of dislocations on the superconductor characteristics is determined according to the Ginzburg-Landau method. Appreciable changes in the stability of the superconductive state are found to occur in the vicinity of dislocations.

SIMULTANEOUS OCCURRENCE OF SUPERCONDUCTIVITY AND FERROMAGNETISM, PART 2: ORDER PARAMETERS

BOGOLYUBOV, N. N. (Jr), YERMILOV, A. N., and KURBATOV, A. M.

[Text] The method of approximating Hamiltonians is used for analyzing the model of a superconductor with magnetic impurities. The asymptotic value of the free-energy function is then calculated in an explicit form. It is also proved that superconductivity and ferromagnetism occur simultaneously.

Theoretical Physics

MODIFIED DECAY IN A COLLISIONAL PLASMA

BERNSHTAM, V. A., All-Union Scientific Research Institute of Electrical Machine and Apparatus Building

[Russian abstract provided by the source]

[Text] An investigation is made of the influence of collisions on the dynamics of modified decay of Langmuir waves. A dispersion equation is derived from the system of equations that describe the modified decay. The relation between the instability increment and the wave number of low-frequency perturbation is found by numerical methods. An examination is made of the problem of the influence that collisions have on decay of a Langmuir wave into a satellite and a low-frequency perturbation. When collisions are taken into consideration, there is a rapid damping of high-frequency waves. A solution is found from the initial system of equations that takes the form of a damped soliton. References 5 (Russian).

CONDITIONS OF SELF-CHANNELING OF LIGHT BEAMS IN NONLINEAR MEDIA

KOLOKOLOV, A. A., candidate of physical and mathematical sciences, SKROTSKIY, G. V., doctor of physical and mathematical sciences, and SUKOV, A. I., Moscow Physico-Technical Institute

[Russian abstract provided by the source]

[Text] The authors consider the conditions of existence of steady-state solutions of a nonlinear wave equation. Requirements are formulated that must be satisfied by the nonlinear permittivity so that the fundamental mode will be stable. It is shown that higher modes are unstable both in a cubic medium and in a medium with saturable nonlinearity. Different mechanisms of disruption of higher modes are described. The results show the possibility of self-channeling of light in inertialess media without the need for solving a nonlinear wave equation. References 16: 11 Russian, 5 Western.

CONCERNING THE QUESTION OF THE RED SHIFT

KACHEVSKIY, D. N., Chuvash State University imeni I. N. Ul'yanov

[Abstract] The author verifies universality of the gravitational red shift in the general theory of relativity in two-dimensional space with Minkowski's metric tensor $h^{\mu\nu} = \mathrm{diag}(1, -1, -1, -1)$ and the gravitational field potential a tensor of order two $\psi_{\mu\nu}$. The proposed theory is a generalization of linear gravitational theories in two-dimensional space. References 7: 3 Russian, 4 Western.

NUMERICAL SOLUTION OF THE TWO-DIMENSIONAL PROBLEM OF SHOCK WAVE PROPAGATION IN OUTER SPACE

SHIDLOVSKAYA, L. V., Moscow

[Russian abstract provided by the source]

[Text] The author considers a technique for numerical solution of the non-stationary two-dimensional problem of a disturbance propagating through interplanetary space due to the release of finite energy within the limits of a truncated cone that models the region of the solar chromosphere occupied by a flare. It is assumed that the energy is released over a time period of 1440-5400 s. Equations are written in spherical coordinates for completely ionized thermally nonconductive hydrogen gas in the one-fluid magnetohydrodynamics approximation. Consideration is taken of the influence of solar gravitation and the radial component of magnetic field strength on motion of the gas. The author briefly discusses questions of the stability of the computational scheme, which is supplemented by artificial viscosity. The curves given for the computational results show satisfactory agreement with observational data. References 10: 6 Russian, 4 Western.

RELATIVISTIC CALCULATION OF ATOMS USING THE THEORY OF ELECTROSTATIC INTER-
ACTION OF ELECTRONS

SHESTAKOV, A. F.

[Russian abstract provided by the source]

[Text] Relativistic Hartree-Fock wave functions of first order and energies
of second order with respect to electrostatic interaction of electrons are
examined by the relativistic Coulomb propagator technique. As an example,
calculations are done for atoms of He, Be, Ne, Hg and the Cu^+ ion. It is
found that the second-order energies differ from the Hartree-Fock values by
less than 1%, and that the first-order wave functions give the Breit inter-
action energy with a good approximation. References 29: 16 Russian, 13
Western.

ON PUMPING OF PLASMONS AND RADIOQUANTA IN TWO-QUANTUM EMISSION OF HYDROGEN
ATOMS

KLEYMAN, YE. B., and OYRINGEL', I. M.

[From REFERATIVNYY ZHURNAL FIZIKA No 1, 1977 Abstract No 1G23 by Ye. P.
Potanin]

[Text] An investigation is made of the feasibility of pumping low-frequency
quanta by the two-quantum transition 2s - 1s with emission of a photon and a
plasmon, and also a photon and a radioquantum. It is shown that as applied
to processes that occur with radiation of Langmuir waves the investigation of
the possibilities of this effect under specific physical conditions requires
detailed analysis of different mechanisms of excitation of the 2s state. The
criterion found for conditions of buildup of rf emission with frequency ω_p
is studied in the two limiting cases of $\omega_p \leqslant \omega_*$ and $\omega_p \gg \omega_*$, where ω_* is the
fine structure frequency of the second level.

THE LANGEVIN EQUATION FOR GREEN'S FUNCTIONS AND THE METHOD OF PROJECTION OPERATORS

LEBEDEV, V. I., Physico-Technical Institute imeni S. U. Umarov, Academy of Sciences Tadzhik SSR

[Abstract] The projection operator technique proposed by R. Zwanzig [Lect. Theor. Phys., v. III, Boulder, Colorado, 1960] is applied to derivation of a generalized kinetic Langevin equation for the classical two-time Green's function of delayed type:

$$G^r(x, x', t) = \Theta(t) < \{ \delta N(x, t); \; \delta N(x', o) \} >,$$

where

$$\delta N = N - <N> = \sum_{l=1}^{N} \delta(x - x_l(t)) - n M(p); \quad x \equiv \{ \vec{q}, \vec{p} \}$$

is the fluctuation of microscopic phase density, M(p) is Maxwell distribution, n is the density of the number of particles, ... is the classical Poisson bracket, $< ... >$ is averaging with respect to the Gibbs ensemble with the Hamiltonian of the system

$$H_N = \int dx \frac{p^2}{2m} N(x) + \frac{1}{2} \int \int dx_1 \, dx_2 \, \Phi(12) \, N(x_1) N(x_2).$$

The equation of motion for the Green's function takes the form

$$\frac{\partial G(t)}{\partial t} = \delta(t) < \{ \delta N(x, o); \delta N(x', o) \} > + \Theta(t) < \left\{ \frac{\partial \delta N(x, t)}{\partial t}; \delta N(x', o) \right\} >.$$

To describe the time behavior of $\delta N(x,t)$ the author uses a Langevin equation obtained from the exact equation by the projection operator P defined by the relation

$$P_{\chi}(\vec{p}) = \int d\vec{p}' \int d\vec{p}'' < \chi(\vec{p}) A(\vec{p}') > \phi^{-1}(\vec{p}'', \vec{p}') A(\vec{p}''),$$

where

$$\phi(\vec{p}', \vec{p}'') = <A(\vec{p}') A(\vec{p}'')>.$$

It is shown that the technique can be used to get different "kinetic" equations for the Green's function. References 9: 2 Russian, 7 Western.

CONCERNING THE BEHAVIOR OF A GYROSCOPE FRAME ON A MOVING BASE

FILIPPOVA, L. O., Moscow State University, Department of Applied Mechanics

[Abstract] The author considers a balanced two-gyro platform with housings joined by an antiparallelogram, the rotors turning in opposite directions. The behavior of the frame with a given law of motion of the base is studied by nutation theory. It is assumed that the angular velocity of the base p' in dimensionless units satisfies the inequality $1/\gamma' \ll p' \ll \gamma'$, where γ' is the dimensionless angular velocity of the rotors. The solution of the equations of motion of the frame is found as an asymptotic expansion, the small parameter being the dimensionless ratio of the angular velocities of base and rotor. Formulas are found for the variables when the axis of the platform returns to its initial position. It is shown that nutation theory improves on the precession approximation by accounting for drifts due to asymmetric distribution of the masses in the housings and rotors relative to the housing axis. References 2 (Russian).

USSR   UDC   533;536.423.1

KINETIC EQUATION AND TRANSFER COEFFICIENTS FOR A MODERATELY DENSE GAS

Leningrad KINETICHESKOYE URAVNENIYE I KOEFFITSIYENTY PERENOSA DLYA UMERENNO
PLOTNOGO GAZA in Russian, 1976, 16 pp (manuscript deposited in the All-Union
Institute of Scientific and Technical Information, 14 Sep 76 No 3315-76 Dep.)

NIMENSKAYA, L. V., editorial staff of Vestnik Leningradskogo universiteta,
Matematika, mekhanika, astronomiya

[From REFERATIVNYY ZHURNAL FIZIKA No 1, 1977 Abstract No 1170DEP]

[Text] The author examines a generalized kinetic equation for a moderately
dense gas derived from the Kadanov-Beim equation by using a statistical
T-matrix. On the basis of this equation, an equation of state is derived
with complete second virial coefficient and the high-temperature asymptotic
formula is calculated for the first density correction of the coefficient of
viscosity that is due to collisional transfer. The results are compared with
studies by other authors. References 16.

USSR   UDC   533;536.423.1

EFFECT OF PHASE TRANSITIONS OF THE FIRST KIND ON THE MOTION OF 'VOLATILE'
AEROSOL PARTICLES

Tomsk VLIYANIYE FAZOVYKH PEREKHODOV PERVOGO RODA NA DVIZHENIYE 'LETUCHIKH'
AEROZOL'NYKH CHASTITS in Russian 1976 6 pp (manuscript deposited in the All-
Union Institute of Scientific and Technical Information, 21 Oct 76 No 3755-
76 Dep)

LIPATOV, G. N., and GENCHEVA, YE. A., editorial board IZV. VUZOV, FIZIKA, ι
Tomsk

[From REFERATIVNYY ZHURNAL, FIZIKA No 1(II), 1977 Abstract No 1164 DEP]

[Text] The hydrodynamic approach to problems of thermal-diffusion phoresis
of large "volatile" aerosol particles does not take into account the effect
of phase transitions at the surface of such particles. Here the authors have
taken into account the "reactive" effect associated with phase transitions
of the first kind. The resulting relation for the force (and velocity) of
diffusion phoresis includes a new term whose magnitude depends on the rate
and the direction of the phase transition. Numerical estimates for water
particles indicate that this effect contributes appreciably to the strength
of diffusion phoresis in highly supersaturated systems. References 15.

THERMODYNAMIC AND MOLECULAR SIMILARITIES BETWEEN THE HEXAFLUORIDES OF SULFUR,
MOLYBDENUM, TUNGSTEN, AND URANIUM.   CRITICAL PARAMETERS OF THE HEXAFLUORIDES
OF GROUP VI, VII, AND VIII ELEMENTS IN THE PERIODIC TABLE

MALYSHEV, V. V.

[Text] A thermodynamic similarity in the behavior of gases of the given group
of substances is established so that, on this basis, universal equations of
state as well as relations for the heat of vaporization, the orthobaric densi-
ties, and the saturated vapor pressure could be derived. The critical param-
eters are then determined for the hexafluorides of group VI, VII, and VIII
elements in the periodic table. With these results, it is now possible to
calculate the thermodynamic parameters of hexafluorides not yet investigated,
within an accuracy adequate for many practical purposes. See also Ref. zh.
Fizika, 1976, Abstract 1011184.

APPARATUS FOR DETERMINING THE COMPRESSIBILITY OF GASES AND THE LIQUID-VAPOR
PHASE EQUILIBRIA IN BINARY AND MULTICOMPONENT SYSTEMS

ROZHNOV, M. S., BUTKO, V. M., DIDOVICHER, E. M., KOZYA, V. G., and
TOPOL'NITSKIY, G. G.

[Text] Test stands for determining the thermophysical properties of sub-
stances over the 90-425 K temperature range under pressures up to $200 \cdot 10^5$
N/m^2 are described here which use standard components as well as special de-
vices. Two of them have been designed for measuring the compressibility of
pure gases and of gas mixtures by the Barnett method. The test stand for
determining the phase equilibria in multicomponent systems is a static appara-
tus. Samples for analysis are taken by discharge and admission techniques.
The test stand for determining phase and volume ratios in binary systems is
of the synthetic type. It operates on the principle of establishing the in-
stant of transition from gaseous state to two-phase state by the appearance

of dew on the mirror surface of a copper prism, and the instant of transition from two-phase state to liquid state from the bending of curves on the p-T (pressure-temperature) diagram. The error of compressibility readings lies within $\pm(0.15-0.07)\%$; the error of data on the relative content of phases coexisting in equilibrium lies within $\pm(3-5)\%$ for multicomponent systems and within $\pm(0.1-0.2)\%$ for binary systems. The error of temperature readings lies within $\pm0.01°C$ and the error of pressure readings lies within $\pm0.02\%$, over the entire test range.

EXPERIMENTAL INVESTIGATION AND DEVELOPMENT OF GENERALIZED METHODS FOR CAL-CULATING THE THERMOPHYSICAL PROPERTIES OF HYDROCARBONS AND THEIR MIXTURES

BOLOTIN, N. K., DREGULYAS, E. K., KOLOMIYETS, A. YA., PROVATOR, V. P., and SHELOMENTSEV, A. M.

[Text]   A method is proposed for calculating the thermal conductivity of light gaseous hydrocarbons. Values of the speed of sound in gaseous methane are given in tables. An algorithm is proposed for approximating functions of many variables by the method of least squares, with the use of orthogonal systems of functions. Also a new variant of the principle of corresponding states has been developed. References 28.

CONDENSATION OF PHOTONS DURING FERROELECTRIC TRANSITION

MAKHVILADZE, T. M., and SARYCHEV, M. YE.

[Text] The study deals with the thermodynamics of a ferroelectric inside a resonator tuned to the wavelength of interband transition (ferroelectric of the displacement type) or tunneling transition (ferroelectric of the order-disorder type). It is shown that at temperatures below some critical point simultaneously with spontaneous polarization there occurs a macroscopic filling of the resonator mode of the electromagnetic field (condensation of photons).

LAMINAR HEAT EXCHANGE IN THE VICINITY OF AN ASYMMETRIC STAGNATION POINT

LESIN, A. B., Moscow

[Abstract] An examination is made of the laminar boundary layer on an obstacle in the vicinity of a stagnation point of an incompressible three-dimensional potential flow that is asymmetric relative to this point (for instance when a jet is incident on the obstacle at an oblique angle). The effect of compressibility is studied on the example of a two-dimensional subsonic flow. A solution is found in a small vicinity of the stagnation point by expansion in series with respect to the longitudinal coordinate, and in a large neighborhood of the stagnation point by the method of localized similarity. It is shown that in this case the maximum heat flux does not coincide with the stagnation point, which is in contrast to the case of symmetric flow. The author thanks V. V. Lunev for formulating the problem and for scientific guidance. Figures 5, references 11: 5 Russian, 6 Western.